VOL. 6 NO. 23
December 15, 1981

# Energy Research Abstracts

ABSTRACTS 34204-35777

Technical Information Center
UNITED STATES DEPARTMENT OF ENERGY

# CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications which are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the energy data base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below.

## PUBLICATIONS OF THE TECHNICAL INFORMATION CENTER

*Energy Abstracts for Policy Analysis (EAPA)*

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize the following: programmatic efforts; legislative, regulatory, and other legal aspects; social, economic, and environmental impacts; regional and sectoral analyses; institutional factors, etc. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; domestic subscribers $4.00, foreign $5.00 per copy; annual cumulative index, domestic $6.00, foreign $7.50 per copy. The annual subscription price is $44.00 for domestic subscribers and $55.00 for foreign subscribers.

*Energy Research Abstracts (ERA)*

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. Indexes are cumulated semiannually and annually. *ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues including a semiannual index and an annual index is $184.00 for domestic subscribers and $230.00 for foreign subscribers. The semiannual and annual indexes will also be available separately to subscribers. The cost for the semiannual index is $18.00 (domestic) or $22.50 (foreign); the annual index is $33.00 (domestic) or $41.25 (foreign). A single issue costs $5.55 (domestic) or $6.95 (foreign).

The following publications are available to the public on a subscription basis from the National Technical Information Service (NTIS), Springfield, Virginia 22161. The annual subscription rate for one volume (calendar) year (12 issues plus cumulative index) is $45.00 for domestic subscribers and $90.00 for subscribers outside the North American Continent. A single issue is $6.00 (domestic) and $12.00 (outside the North American Continent).

*Current Energy Patents (CEP)*

A monthly publication providing abstracting and indexing coverage of the international patent literature, including patent applications, that concerns any aspect of energy production, conservation, and utilization. Available as PB81-902800.

*Energy Conservation Update (ECU)*

A monthly abstract journal devoted to current information on energy conservation in buildings, transportation and propulsion, and industry; waste processing plants and equipment; energy storage; energy conversion; advanced automotive systems; combustion systems; power cycles; synthetic fuels; and power transmission. Available as PB81-914800.

*Energy and the Environment (EAE)*

A monthly abstract journal devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment. Available as PB81-914900.

*Fossil Energy Update (FEU)*

A monthly abstract journal devoted to information on the processing and use of fossil fuels. Available as PB81-914600.

*Fusion Energy Update (CFU)*

A monthly abstract journal devoted to information on controlled thermonuclear research. Available as PB81-915300.

*Geothermal Energy Update (GEU)*

A monthly abstract journal devoted to information on the exploration and development of geothermal resources. Available as PB81-914700.

*Solar Energy Update (SEU)*

A monthly abstract journal devoted to information on the utilization of solar, tidal, and wind energy. Available as PB81-914500.

*Synthetic Fuels Update (SFU)*

A monthly abstract journal devoted to information on coal gasification; coal liquefaction; other coal processing; biomass conversion to fuel; shale oil and tar sand bitumen production; hydrogen fuels; other hydrocarbon fuels; alcohol fuels; and inorganic hydrogen compound fuels. Available as PB81-902700.

## INTERNATIONAL ENERGY PUBLICATIONS

*Atomindex* (Published in cooperation with the Technical Information Center by the International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria)

A semimonthly abstract journal devoted to information on nuclear science and technology. Through an exchange agreement, IAEA/INIS provides all non-U. S. nuclear information of *Atomindex* to TIC for inclusion in the DOE/RECON Data Base; in turn, TIC provides all U. S. nuclear information to IAEA/INIS for inclusion in *Atomindex*. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

*Coal Abstracts* (Published in cooperation with the Technical Information Center by the International Energy Agency, IEA Coal Research, London, England)

A monthly abstract journal devoted to information on coal. Through an exchange agreement, IEA Coal Research provides all non-U. S. coal information of *Coal Abstracts* to TIC for inclusion in the DOE/RECON Data Base; in turn, TIC provides all U. S. coal information to IEA Coal Research for inclusion in *Coal Abstracts*. *Coal Abstracts* is available to Department of Energy components and contractors from. the Technical Information Center. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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## Editor's Note

Printed cumulative indexes will be prepared for *Energy Research Abstracts (ERA)*, Volume 6 for 1981. The Volume 7, 1982 subscription will provide the 24 semi-monthly issues only. No printed cumulative indexes will be prepared for *ERA*, Volume 7, 1982. For those not making use of one or more of the on-line systems, TIC expects to make available a microfiche version of *ERA* annual indexes for Volume 7. Sources and prices for these microfiche will be announced at a later date.

With Volume 7, the coverage of *Energy Research Abstracts* will be broadened to announce all unclassified, publicly available reports processed by the Technical Information Center. This coverage increase will result in the inclusion of 10,000 additional abstracts. Discontinuance of the cumulative indexes will offset the cost of this additional coverage.

The total content of *ERA* is maintained on a continuing basis in the Energy Data Base (EDB). EDB is available for searching via the DOE/RECON on-line system and is also available commercially via Bibliographic Retrieval Service (BRS). Commercial availability via Dialog and Orbit will be added in the fall. This widespread availability of constantly cumulating indexes to *ERA* information decreases the usefulness of printed cumulative indexes to an impractical level.

The editorial staff believes its decision to rely on computerized systems for retrospective searching is both forward thinking and cost-effective. It is expected that any inconvenience to *ERA* users will be minimal.

Dave E. Bost

energinfo ERA

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# ENERGY RESEARCH ABSTRACTS

**ABOUT THE TECHNICAL INFORMATION CENTER**

The Technical Information Center, as the national information center for the Department of Energy, manages, publishes, and disseminates scientific, technical, and practical energy information acquired from worldwide sources. It builds and maintains energy information data bases used to prepare abstracting journals, bibliographies, and literature searches. The data bases are also searchable via the Department's on-line retrieval system, DOE/RECON. This information is provided to DOE program offices and contractors; scientists; engineers; educational, commercial, and industrial communities; and the general public. The Technical Information Center conducts an active announcement and marketing program. It establishes policy and administers control of an inventory and registry for DOE publications. The Center also develops and evaluates new and effective information systems and services as required by scientific and technical management within the Department of Energy.

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## ABOUT *ENERGY RESEARCH ABSTRACTS*

*Energy Research Abstracts (ERA)* provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers, and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

*ERA* is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, conservation, safety, environmental impacts, and regulation.

*ERA* is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Federal, state, and municipal agencies concerned with energy development, conservation, and usage may obtain *ERA* free of charge. Inquiries should be directed to the Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

*ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues including a semiannual index and an annual index is $184.00 for domestic subscribers and $230.00 for foreign subscribers. The semiannual and annual indexes are also available separately to subscribers. The cost for the semiannual index is $18.00 (domestic) or $22.50 (foreign); the annual index is $33.00 (domestic) or $41.25 (foreign). A single issue costs $5.55 (domestic) or $6.95 (foreign).

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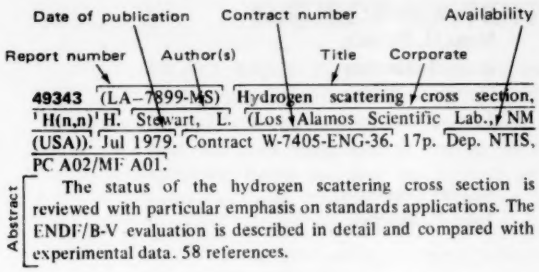
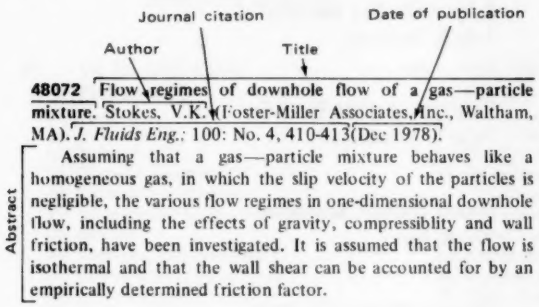
# HOW TO USE *ENERGY RESEARCH ABSTRACTS*

## •ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Date of publication
Contract number
Availability
Report number
Author(s)
Title
Corporate
49343 (LA–7899-MS) Hydrogen scattering cross section, $^{1}H(n,n)^{1}H$. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.
Abstract
The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.


Journal citation
Date of publication
Author
Title
48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). J. Fluids Eng.: 100: No. 4, 410-413 (Dec 1978).
Abstract
Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

## •INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. These indexes are cumulated semiannually and annually. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

## •Corporate Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

**49343** (LA–7899-MS) Hydrogen scattering cross section, $^{1}H(n,n)^{1}H$. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

is indexed as:

**Los Alamos Scientific Lab., NM (USA)**
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, $^{1}H(n,n)^{1}H$, 4:49343 (LA–7899-MS)

## •Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

**Stewart, L.**, Hydrogen scattering cross section, $^{1}H(n,n)^{1}H$, 4:49343 (LA–7899-MS)
**Stewart, M.D.**, *See* McInroy, J.F., 4:49280
**Stewart, W.**, *See* Dean, J.W., 4:48543
**Stimson, J.**, Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

## •Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles and informative phrases, or both, specific to these entries are arranged alphabetically under the entries.

**HYDROGEN I TARGET**
**Neutron Reactions**
Hydrogen scattering cross section, $^{1}H(n,n)^{1}H$ (Above 100 keV, review), 4:49343 (LA–7899-MS)
**HYDROGEN NITRATES**
*See NITRIC ACID*
**HYDROLOGY**
**Research Programs**
Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, 96*th* Congress, 4:48749.

## •Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

| | | |
|---|---|---|
| **W-7405-ENG-36** | **Los Alamos Scientific Lab., NM (USA)** | |
| | 3:49698 | LA-tr–78-45 |
| | 3:49857 | LA–7224T |
| | 3:49863 | LA–7235-MS |
| **W-7405-ENG-48** | **California Univ., Livermore (USA). Lawrence Livermore Lab.** | |
| | 3:49386 | UCRL–52456 |
| | 3:49431 | UCRL–52405 |

## •Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience.

| | | |
|---|---|---|
| **LA-** | | |
| 7899-MS | 4:49343 | Dep. NTIS, PC A02/MF A01 |
| **LA-tr-** | | |
| 78-69 | 4:48158 | Dep. NTIS, PC A03/MF A01 |

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# SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts.* The following listing includes the totality of the 40 first-level and 294 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope notes is available as DOE/TIC-4584-R4 from NTIS for $7.00.


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# SUBJECT CONTENTS (ALPHABETICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 294 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope notes is available as DOE/TIC-4584-R4 from NTIS for $7.00.


**33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS**
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- 07 Emission Control
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# ENERGY RESEARCH ABSTRACTS

## 01 COAL AND COAL PRODUCTS

**34204 (ORNL—5802) Fossil Energy Program. Quarterly progress report for the period ending June 30, 1981.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 378p. NTIS, PC A17/MF A01. Order Number DE82000505.

This quarterly report covers the progress made during the period April 1 through June 30 for the Oak Ridge National Laboratory research and development projects that are carried out in support of the increased utilization of coal and other fossil fuels as sources of clean energy. These projects are supported by various parts of DOE including Fossil Energy, Basic Energy Sciences, Office of Health and Environmental Research, Office of Environmental Compliance and Overview, Economic Regulatory Administration, Policy and Evaluation, Resource Applications, by the Electric Power Research Institute, and by the Tennessee Valley Authority and the EPA Office of Research and Development through interagency agreements with the DOE.

### 0104 Processing

*REFER ALSO TO CITATION(S) 34233, 34234, 34235, 34236, 34237, 34242, 34243, 34244, 34267, 35090, 35356*

**34205 (ANL/FE—81-57) Density-measurement studies at the BI-GAS pilot plant.** Sheen, S.H.; Raptis, A.C. (Argonne National Lab., IL (USA)). Sep 1981. Contract W-31-109-ENG-38. 17p. NTIS, PC A02/MF A01. Order Number DE82000910.

The Argonne National Laboratory has developed and tested an acoustic flow/no-flow monitor for the char return line of the BI-GAS pilot plant. The indicator has operated successfully for the last three years. It has been observed that the strength of the microphone signal was related to the amount of char in the line. In a recent experiment at BI-GAS this observation was further explored, and it was found that the signal is related to the char valve opening in the frequency range of 1 to 20 kHz. This is a clear indication that the flow/no-flow indicator can be upgraded to a density meter and consequently to a true mass flowmeter. This can be done by installing another flow/no-flow indicator upstream or downstream of the existing one and cross-correlating the two signals.

**34206 (DOE/ET/10104—12) Solvent-refined coal (SRC) process. Final report.** (Pittsburg and Midway Coal Mining Co., Englewood, CO (USA)). Aug 1981. Contract AC05-76ET10104. 87p. NTIS, PC A05/MF A01. Order Number DE81031937.

In late 1979 the Pittsburg & Midway Coal Mining Co. (P & M), recommended to the Department of Energy (DOE) that certain areas of the SRC Pilot Plant should be modified to represent the SRC-II Demonstration Plant design. The proposed modifications were for design confirmation; start-up, transient and other operational guidance studies; and training of operator and professional personnel. The pilot plant facilities proposed for modification were: Coal Slurry Mixing - Area 01; Dissolver Effuent Cooling and Separation - Area 02; and Vacuum Flash/Residue Pump Testing - Area 04. A summary justification assessment for the modifications is included. A preliminary engineering study by Badger Energy, Inc. (BEI) was completed in late 1980. A proposal to begin detailed engineering had been submitted to DOE for approval when all work was discontinued at the direction of the DOE in April 1981.

**34207 (DOE/ET/10154—T16) Solvent refined coal process: operation of the solvent refined coal pilot plant, Wilsonville, Alabama. First quarter report, January-March 1981.** Lewis, H.E. (Southern Co. Services, Inc., Birmingham, AL (USA); Catalytic, Inc., Wilsonville, AL (USA)). 1981. Contract AC22-76ET10154. 142p. (FE—2270-88). NTIS, PC A07/MF A01. Order Number DE82000420.

This report summarizes the operating conditions and test results obtained during the first quarter of 1981 at the six ton per day solvent refined coal (SRC-I) pilot plant in Wilsonville, Alabama. The plant operated for approximately two-thirds of the period with a scheduled shutdown, from 22 February to 17 March, accounting for most of the downtime. Kentucky 9 coal from the Fies mine was processed throughout the period. The following potential process improvements and tests were evaluated in the respective process units. SRC Unit: Low severity run tests to evaluate SRC reactor conditions for two-stage liquefaction; process solvent quality studies while simulating demonstration plant conditions with low quality process solvent (anthracene oil); operation of the new, reduced volume and residence time, V103 High Pressure Separator; Evaluation of the hot separator mode of operation; and adjustment of the T102 Vacuum Column operation to determine if it can produce a combined trays 3 and 8 stream that would be an acceptable process solvent (95% boiling at over 450°F). CSD Unit: Steam stripping of SRC and LSRC to reduce product-related DAS losses; and ambient and cryogenic SRC sampling comparisons for DAS determination tests. Pressure checking of the hydrotreater unit was completed, and the Dowtherm system was placed in service. Solvent circulation was initiated in the unit as efforts continued to verify equipment performance.

**34208 (DOE/ET/10495—T2) Catalytic hydrogenation of coal-derived liquids. Interim report, March-May 1981.** Berg, L.; McCandless, F.P. (Montana State Univ., Bozeman (USA). Dept. of Chemical Engineering). Jul 1981. Contract AC22-76ET10495. 50p. NTIS, PC A03/MF A01. Order Number DE81030485.

Two runs of more than 100 hours of catalyst life were completed using SRC-I and SRC-II as the feeds. One run had catalyst regeneration every three hours, the other every eight hours. The catalyst, 4% CoO, 8% $MoO_3$, 1% NiO and 8% $WO_3$ on NALCO-78-6008C alumina base, reduced the nitrogen content to less than 0.3% and showed no signs of deterioration in activity. Regeneration after the three or eight hour periods was by burnoff with oxygen in nitrogen followed by re-sulfiding with $H_2S$ in hydrogen. The liquid yield from SRC was 90% of which 30% was 50 to 204° C. boiling range gasoline. It appears that a viable process to convert SRC into a feedstock acceptable to a petroleum refinery has been discovered. A study of the effect of carbon laydown on pore volume and subsequent deactivation of the catalyst was carried out in a pressurized batch reactor. Little reduction in pore volume was noted. Three commercial catalysts, Harshaw HT400, NALCO MO477 and NALCO MN502, were evaluated with SRC-II. These catalysts are capable of giving specification grade denitrogenation for up to five hours. The effect of added water to the feed stream lengthened the cycle time for the HT400 catalyst. About 25% of the liquid product is in gasoline boiling range.

**34209 (DOE/ET/14705—22) Bi-Gas Pilot Plant Operation. Quarterly technical progress report, October 1-December 31, 1980.** (Stearns-Roger, Inc., Denver, CO (USA)). 1980. Contract AC01-80ET14705. 139p. NTIS, PC A07/MF A01. Order Number DE82000223.

At present, the major developmental effort is concentrated on gasification. Broadly, current goals are to assess the viability of the process from an operating and cost standpoint, determine possible improvements and obtain design data for a full-scale plant. As is

typical for developmental projects of this magnitude, a large number of operating difficulties have been experienced and overcome since the first operations in August of 1976. Currently the overcoming of operating difficulties still requires some effort. However, most tests are stable and allow the gathering of process design data in the form of validated heat and material balances. These are applied in model simulations of gasifier operation.

34210 (DOE/ET/60058—T1, pp vp, Paper 6) **Coal desulfurization.** Knight, J.A.; Hurst, D.R.; Elston, L.W. (Georgia Inst. of Technology, Atlanta). 1980. NTIS, PC A07/MF A01.

In Cooperative program of applied energy research and technology development. Final technical report, October 1, 1979-December 31, 1980.

The purpose of this study was to explore the feasibility of partially desulfurizing pulverized coal by exposure to a heated stream of inert gas. The preliminary data from the free-fall experiments indicate that the technique is one that can yield useful and meaningful results on the desulfurization and volatilization of coal samples in a dilute phase mode. For example with the Kentucky coal using the free-fall apparatus, the results showed that the agglomerating characteristics of this particular coal had to be minimized to reduce the amount of material that would collect on the walls of the reactor. Samples of Kentucky coal were pretreated, as described in the Experimental Section. This treatment reduced the amount of material adhering to the reactor walls by approximately 50%. The data from preliminary experiment 6 with the Kentucky coal are indicative of the potential reductions in sulfur that can be obtained. If it is assumed that the sulfur components in the volatiles can be removed and that both the coke and the sulfur-free volatiles are used as a combined fuel, then the sulfur content of the original coal has been reduced by approximately 46 per cent. The data from the preliminary experiments with both the nontreated and treated Illinois coal indicated that the sulfur content, based on the assumptions above for the combined fuels, could be reduced significantly. The reduction with the nontreated coal was approximately 31 per cent, experiment 10, and with the treated coal was approximately 57 per cent, experiments 14 and 15. These data are sufficiently encouraging that this technical approach has promise as a method for the desulfurization of coal to acceptable levels.

34211 (DOE/METC/SP—184) **Fixed-bed gasification.** (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Jan 1981. 29p. NTIS, PC A03/MF A01. Order Number DE82000432.

Since the completion of construction in 1967, the METC Gasifier Pilot Plant has produced data and demonstrated operation on all major ranks of US coals. In 1976, METC began an expansion program to include a novel gas-cleanup facility to evaluate the environmental problems associated with gasification plants and also to develop improved cleanup systems. The construction and checkout of this full-scale cleanup system was completed within the past year and the pilot-plant facility now has the capability of gasifying all US coals and producing a relatively tar-, oil-, particulate-, and sulfur-free fuel gas. The Department of Energy's (DOE) fixed-bed gasification development program includes other facilities that provide DOE with a broad capability to address alternative- and advanced-gasification technologies. In addition to utilizing these facilities to evaluate and improve gasification/cleanup-system configurations, the pilot plants are also being used to support a number of related projects.

34212 (DOE/PC/30264—09) **Controlled-flash pyrolysis. Third quarterly technical progress report, April-June 1981.** Durai-Swamy, K.; Che, S.C.; Chen, C.B.; Jain, R.; Kim, S.S.; Von Schonfeldt, H. (Occidental Research Corp., Irvine, CA (USA)). Aug 1981. Contract AC22-80PC30264. 55p. NTIS, PC A04/MF A01. Order Number DE82000284.

Thirteen runs were made in the Controlled Flash Pyrolysis unit with a coal feed rate of about 2 kg/hour. Preliminary material balance for these tests is presented. The laboratory scale (1 gm/min.) pyrolysis reactor was used to evaluate several model compounds as quench solvents. Free radical pyrolysis studies, using an Electron Spin Resonance spectrometer, have shown that vapor phase radicals from coal pyrolysis resemble phenalenyl radical and that char placed on top of the pyrolyzing coal absorbs these vapor phase radicals effectively.

34213 (DOE/RA/50006—T1) **Verification of the foreign synfuels industrialization experience. Final report.** (Radian Corp., McLean, VA (USA); Institute of Gas Technology, Chicago, IL (USA); Research Planning Associates, Paris (France)). Sep 1981. 88p. NTIS, PC A05/MF A01. Order Number DE82000230.

A survey of foreign commercial gasifiers has been conducted for the US Department of Energy (DOE). The purpose of this effort was to provide DOE with information on the type of data that is currently available from the foreign commercial gasifier experience. From this program effort, the potential availability and value of data from foreign facilities to the US synfuels development effort may be assessed by DOE. The specific objectives of this program were to develop and verify a master list of commercial gasifiers operating in foreign countries and to conduct two case studies (site visits) of specific facilities. The list of operating foreign gasifiers is presented in Appendix A of this report. The master list contains facilities which are currently operating or have been shut down for less than five years. For this study, it was assumed that facilities which have been shut down for a period greater than five years would not represent viable sources of information. This list represents the set of sources from which gasifier operation information is potentially available.

34214 (EPRI-AF—590-Vol.2) **Modeling and analysis of moving-bed coal gasifiers. Final report.** Yoon, H.; Wei, J.; Denn, M.M. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering). Feb 1978. 59p. NTIS, PC A04/MF A01. Order Number DE82900039.

A steady-state simulation model of moving bed coal gasification reactors was developed in volume 1. The simulation model is applied in this volume to a pressurized slagging reactor. Results are compared to data from a pilot scale experimental reactor, and reactor performance is examined over a range of operating conditions. The transient response of Lurgi and slagging reactors to small step changes from optimum feed conditions is studied by use of the simulation model together with a pseudo-steady state approximation. Predictions include the temperature and composition of the product gas as functions of time, the movement of the combustion zone in the Lurgi reactor, and the change in bed height in the slagging reactor.

34215 (LBL—9963-Rev.) **Oxydesulfurization of coal by acidic iron sulfate solutions.** Mixon, D.A.; Vermeulen, T. (Lawrence Berkeley Lab., CA (USA)). Aug 1981. Contract W-7405-ENG-48. 161p. NTIS, PC A08/MF A01. Order Number DE82000464.

Thesis. Submitted by D.A. Mixon.

To facilitate by-product recovery and eliminate elemental sulfur formation in coal oxydesulfurization, high-sulfur bituminous coal has been treated with aqueous ferric sulfate/sulfuric acid and oxygen at 100 to 150°C. The rate of pyrite oxidation increases with oxygen partial pressure, temperature, and fineness of grinding. This reaction rate is relatively insensitive to sulfuric acid and ferric sulfate concentrations, so that pyrite removal may be satisfactorily performed in solutions containing 25% $H_2SO_4$ and 12% $Fe_2(SO_4)_3$ (weight percentages relative to total $H_2O$ plus $H_2SO_4$); preliminary data suggest that such a leaching solution is only mildly corrosive to T316 stainless steel, at 150°C or below, in the presence of oxygen. To provide an accurate assessment of coal oxydesulfurization stoichiometry, an analytical technique based on uv spectrophotometry has been developed for the determination of elemental sulfur in coal. Prepared coal samples are extracted for 24 hours with cyclohexane. Other exploratory oxydesulfurization runs have shown that vanadium oxides are not effective catalysts at 100°C, with oxygen. Nor are lauryl sulfate or sulfates of zinc, copper, or manganese effective additives in the ferric sulfate/sulfuric acid/oxygen system at 150°C. Elemental chlorine has been shown to be capable of removing significant amounts of organic sulfur from coal, at 74°C, but suffers the drawback of chlorinating the coal's orgaic matrix. Hydrogen peroxide in aqueous sulfuric acid is an effective reagent for pyrite removal at 100°C, but is unduly expensive.

**34216** (LBL—11983, pp 3.20-3.23) **Selective hydrogenation of coal.** Grens, E.; Vermeulen, T.; Bowyer, D.; Edwards, J.; Hershkowitz, F.; Maienschein, J.; Onu, C.; Zieminski, G. Mar 1981. NTIS, PC A03/MF A01. Order Number DE81030532.

In Chemical process research and development program, FY 1980.

This project's aim is to convert coal to liquid products by using homogeneous catalysts that can promote selective scission of certain linkages in the coal structure below coal pyrolysis temperature. These linkages join conjugated hydroaromatic groups in the coal, and include aliphatic and $O_2$ (ether) bridges. The catalysts are dissolved in, or constitute, a liquid reaction medium, which has access to the extensive interior pore surfaces in the coal. Included in this research program are studies of the interaction of organic solvent media with coals, the effects of homogeneous catalysts in promoting reactions at moderate temperatures, and the use of inorganic, Lewis-acid type melts as catalytic media for coal conversion. The acting of the catalytic treatments on model chemical compounds containing certain types of bond structures found in coal is examined to elucidate the mechanisms of coal decomposition. Transport processes for coal reaction products and dissolved $H_2$ gas are considered to determine the extent to which these processes may limit conversion rates. Since 1978 the major effort has been directed to the use of mixed organic-inorganic treatment media, in particular $ZnCl_2$ melts in combination with hydroaromatic solvents (e.g., tetralin) or with alcohols (e.g., methanol). This type of coal treatment was found to be much more effective than treatment with either organic or inorganic media separately, doubling or tripling conversions compared to those obtained with treatment in a single medium under the same temperature conditions.

**34217** (LBL—11983, pp 3.24-3.27) **Coal desulfurization.** Vermeulen, T.; Ergun, S.; Lynn, S.; Petersen, E.; Clary, L.; Cremer, G.; Mixon, D.; Smith, M. Mar 1981. NTIS, PC A03/MF A01. Order Number DE81030532.

In Chemical process research and development program, FY 1980.

The removal of sulfur from coal by means of alkylation with $Na_2CO_3$ and oxidation of organic sulfur and pyrite was studied. Such use of $Na_2CO_3$ would tend to be more expensive than stack-gas cleaning, and would thus be desirable only in special cases. Although pyrite-oxidation treatments do not remove organic S from coal, the results suggest that S compounds in coal are somewhat altered. Exploratory extractions with liquid $SO_2$ at 150°C gave ambivalent results, sometimes yielding a modest reduction and sometimes an increase. The use of two or more reaction steps in series is now viewed as essential and is believed to constitute a promising approach. S removal from coal has been investigated with the use of an aqueous oxidizing medium comprising $Fe_2(SO_4)_3$, $O_2$, and $H_2SO_4$. This mixture markedly reduces water consumption and waste disposal; the by-products of coal treatment can be recovered in marketable form. (DMC)

**34218** **(LBL—13238) Coal liquefaction research, October 1, 1978-September 30, 1981.** Heinemann, H. (Lawrence Berkeley Lab., CA (USA)). Sep 1981. Contract W-7405-ENG-48;FG22-78ET11432. 64p. NTIS, PC A04/MF A01. Order Number DE81030379.

Progress reports are presented for the following two areas: catalytic cracking studies with water-wet silica-alumina catalysts; and Fischer-Tropsch reactor studies where similarities and differences between fixed bed and slurry type reactors are investigated and further experiments conducted to measure mass transfer coefficients and reaction kinetics which are to be used in a model slurry reactor. The following are some of the conclusions. (1) The premise that the presence of liquid water might increase catalytic cracking activity was found to be invalid. It was demonstrated that cracking can occur at previously unobserved low temperatures (though at low conversions) and that an anomaly exists in that one of the catalysts tested shows an entirely different cracking behavior and probably follows a different cracking mechanism. (2) the diameter of a fixed-bed Fischer-Tropsch reactor critically affected the resistance of the reactor to plugging caused by the build up of carbonaceous or waxy deposits. Plugging was very likely due to local nonuniformity in the catalyst temperature. Decreasing the reactor diameter at a fixed gas space velocity, should improve temperature uniformity by decreasing the length of the thermal conduction path and increasing the extent of convective heat transfer from each catalyst particle. Suppression of plugging at higher $H_2/CO$ ratios is likely due to a reduction in the product average molecular weight and the reaction with hydrogen of carbon deposited via the Boudouard reaction. A slurry bed reactor with its much greater isothermicity can be expected to behave similarly to very small diameter fixed bed reactors and therefore have a higher tolerance of lower $H_2/CO$ ratio feed gas.

**34219** **(MLM—2849) Temperature-time-reacton medium controlled hydropyrolysis: a batch reactor study.** Park, W.K.; Mayer, R.L. (Mound Facility, Miamisburg, OH (USA)). 15 Jul 1981. Contract AC04-76DP00053. 80p. NTIS, PC A05/MF A01. Order Number DE82000099.

A parametric study was conducted on the ultrafast rate (UFR) hydropyrolysis of coal under controlled temperature-time-reaction medium (TTR) conditions to gain better understanding of, and to determine optimum operating conditions for, the hydropyrolysis system. A batch reactor consisting of four functional sections was devised for the first phase of this study; it provides the required reaction conditions incorporating explosive heating, sonic-jet mixing, short reaction time, and aerodynamic quenching. This reactor was operated to subject the coal to the ultrafast rate reactions under various TTR profile conditions. Using powdered coal as the primary feed, results have shown that: (1) the UFR technique is a viable method for the hydropyrolysis of coal; (2) under UFR reaction conditions, i.e., $<1$ ms reaction time, the TTR profile to which the coal powders are exposed governs the final product distribution; and (3) this reaction technique permits 20 to 90% conversion of coal. A design for a continuous-flow version of the reactor was established based on these findings.

**34220** **(SAND—81-0211C) Reversibility of coal liquefaction.** Thomas, M.G.; Bickel, T.C.; Trudell, D.E. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 16p. (CONF-811108—3). NTIS, PC A02/MF A01. Order Number DE81027804.

From Annual meeting of the Institute of Chemical Engineers; New Orleans, LA, USA (8 Nov 1981).

The dissolution of coal has been shown to be affected by the amount of preasphaltenes formed. This effect is related to the repolymerization of preasphaltenes when solvent quantity and/or quality are limited. Repolymerized preasphaltenes are shown to be reactive. This reactivity suggests that a process reversibility exists for this first step of the liquefaction sequence and helps to explain limited solvation for early stage liquefaction. This reversibility is direct evidence that gas formation (which accompanies these reactions) is a non-essential side reaction that is a consequence of time at temperature, not the interconversion of coal derived materials. Asphaltenes, in a solvent deficient system, disproportionate to oils, preasphaltenes, and insoluble organic material. The addition of asphaltenes, both laboratory and process derived, increases the amount of oil produced. Without concurrent increase in hydrogen availability, this increase in oil is accompanied by some polymerization of the asphaltenes. Process reversibility is thus observed for both the primary and secondary step of liquefaction, those related with early stages of liquefaction. These data are consistent with a sequential reaction path and the utilization of a multistep liquefaction process. The effect of increases in hydrogen availability by chemical spikes and/or H-donor molecules has been shown to partially compensate for the solvent deficiencies observed in the later stages of processing.

**34221** **(SAND—81-1941C) Effect of thermomechanical properties on initial cavity growth.** Glass, R.E. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 21p. (CONF-810923—9). NTIS, PC A02/MF A01. Order Number DE81030839.

From 7. underground coal conversion symposium; Fallen Leaf Lake, CA, USA (8 Sep 1981).

Recent field and laboratory studies in UCG have indicated that the thermomechanical properties of coals may be the controlling parameters in determining initial cavity growth. To examine this possibility laboratory and modeling efforts are being directed at determining these properties and incorporating them in a cavity growth model. The results of the work emphasize the critical role

that anisotropic strengths play in determining the shape of the cavity.

**34222 (UCRL—53144) Podmoskovnaya underground coal-gasification station.** Olness, D.U. (Lawrence Livermore National Lab., CA (USA)). 15 May 1981. Contract W-7405-ENG-48. 81p. NTIS, PC A04/MF A01. Order Number DE81030632.

This report continues our survey of the Soviet effort in underground coal gasification and summarizes research conducted at the Podmoskovnaya Station until its close in 1963. Techniques for in situ coal gasification without using underground labor to create the necessary channels were employed. Countercurrent combustion linking, electrolinking, hydraulic fracturing, and inclined-horizontal drilling were among the linking methods applied to the relatively flat seams of lignite found near Tula. By the late 1940s, improvements at the Podmoskovnaya Station enabled the Soviets to operate the facility primarily as a small industrial station. This report discusses the geological, hydrological, chemical, technological, and economic factors affecting construction, process optimization, operation, and maintenance of in situ generators. Available data for individual generators operated at the Podmoskovnaya Station are also presented. 59 figures, 59 tables.

**34223 (UCRL—85907) Effects of gas-flow pattern on cavity shape.** Creighton, J.R. (Lawrence Livermore National Lab., CA (USA)). 22 Jul 1981. Contract W-7405-ENG-48. 16p. (CONF-810923—10). NTIS, PC A02/MF A01. Order Number DE82000347.

From 7. underground coal conversion symposium; Fallen Leaf Lake, CA, USA (8 Sep 1981).

The effects of different gas flow patterns on the cavity shape in laboratory scale coal block experiments are shown. For simplicity, the burning of pure carbon, rather than coal is modeled. The rate of removal of carbon from the cavity wall is shown to depend on the local rate of oxygen transport to the wall. A numerical model which assumes plug flow in the cavity with a laminar boundary layer gives cavities shaped like an exponential horn, with the largest radius next to the inlet. The downstream shape is in reasonable agreement with experiment but the upstream shape differs. When the flow in the cavity is calculated using the full Navier-Stokes equations the flow near the inlet resembles an expanding jet surrounded by a torroidal vortex. The maximum rate of oxygen transport to the wall occurs where the jet strikes the converging cavity wall some distance downstream. The reduced oxygen transport near the inlet causes the upstream portion of the cavity to be rounded, in agreement with experiment. The downstream portion of the cavity is similar to that with plug flow.

**34224 Application of radiation techniques to coal liquefaction.** Sample, D.G.; Thomas, M.G. (Sandia Lab, USA). *Materials Evaluation ;* **39**: No. 5, 455-458(Apr 1981).

Current direct coal liquefaction processes, both catalytic and non-catalytic, require heating of a coal-solvent slurry at temperatures above 400/degree/C and pressures of approximately 2000 psi. These severe conditions, coupled with continuous operation, make in situ monitoring of the processes and equipment difficult, when compared to static conditions. This paper discusses experiences with many standard radiation techniques for analyzing coal, coal residues, and catalysts used for coal liquefaction including transmission electron microscopy, scanning electron microscopy, electron microprobe, X-ray diffraction and X-ray fluorescence. In addition, X-radiography has been successfully used in several non-routine ways for the analysis of static and dynamic conditions associated with coal liquefaction.

**34225 Kinetics of coal hydrogenation.** Bhatt, B.L.; Ziegler, E.N. (Brookhaven Natl Lab, Upton, NY). *Journal of the Institute of Energy ;* **54**: No. 418, 12-20(Mar 1981).

A kinetic study of coal devolatilization and hydropyrolysis is conducted using 15-20 mg of coal, at 10.4 MPa pressure. Batch experiments are performed at /less than equivalent to/625/degree/C/s heating rates by passing electric current through stainless steel screens containing known weights of dry pulverized North Dakota lignite (53-149 /mu/m). Kinetic data are obtained from the weight loss of coal and from the concentrations of the evolved products, measured by a gas chromatograph. 28 refs.

**34226 Synthetic fuels from nuclear energy and coal.** Steinberg, M. (Brookhaven National Lab., Upton, NY). pp 61a-77a of Proceedings of third annual energy seminar. Erie, PA; Gannon University (1981).

From 3. annual energy seminar; Erie, PA, USA (31 Mar 1981).

Fusion reactors could displace a large amount of the coal needed for synthetic fuel production. A fusion reactor can supply high temperature steam in the range of 1000 to 1500°C continuously. The high temperature steam would be obtained by internal heating of a refractory containing blanket section which would absorb the neutrons from the plasma. The water process stream would absorb the heat from the refractory, producing high temperature steam. The high temperature steam could be electrolyzed in a high temperature electrolyzer (HTE) and converted in a high temperature steam gasifier (HTSG) with coal. The major advantages of the fusion reactor HTE-HTSG system for synthetic fuels includes: (1) an increase in utilization of the coal resource by a factor of 2 to 3 respectively for liquid and gas production; (2) a 2-to-3-fold reduction in the environmental pollution factors which include: (a) reduced mining hazards; (b) reduced release fo the toxic agents, S, N and ash; and (c) reduced buildup of $CO_2$ in the atmosphere which could lead to a catastrophic climatic greenhouse effect. 5 figures, 9 tables.

**34227 Chemical desulphurization of coal.** Morrison, G.F. London, England; IEA Coal Research (1981). 72p. (ICTIS/TR—15).

The recent literature relating to the chemical desulfurization of coal, is reviewed. Following an assessment of the forms of organic and pyritic sulfur in coal and the potential chemical reactions these may undergo, fifteen processes for the chemical cleaning of coal which are currently under development are described and evaluated. These include the PETC process; the Ames wet oxidation process; the Ledgemont process; the ARCO promoted oxidation process; the TRW Meyers desulfurization process; the TRW Gravichem process; the JPL chlorinolysis process; the KVB process; the Battelle hydrothermal process; the TRW Gravimelt process; the General Electric microwave treatment process; the Aquarefined coal process; the Magnex process; the IGT flash desulfurization process; and a chemical comminution process. It is concluded that with the present state of knowledge the additional sulfur removed by chemical cleaning processes compared with that removed by physical cleaning processes is insufficient to justify the additional complexity and hence cost of preparation. Much more fundamental research is required to elucidate the modes of occurrence and chemistry of sulfur in coal, particularly of organic sulfur, before the efficiency of the chemical cleaning of coal can be improved. 116 references.

**34228 Method and apparatus for acoustically monitoring the flow of suspended solid particulate matter.** Roach, P.D.; Raptis, A.C. (to Dept. of Energy). US Patent Application 209,928. 24 Nov 1980. 15p.

A method and apparatus for monitoring char flow in a coal gasifier system includes flow monitor circuits which measure acoustic attenuation caused by the presence of char in a char line and provides a char flow/no flow indication and an indication of relative char density. The flow monitor circuits compute the ratio of signals in two frequency bands, a first frequency band representative of background noise, and a second higher frequency band in which background noise is attenuated by the presence of char. Since the second frequency band contains higher frequencies, the ratio can be used to provide a flow/no flow indication. The second band can also be selected so that attenuation is monotonically related to particle concentration, providing a quantitative measure of char concentration.

**34229 Memphis demonstration plant program for coal gasification.** Patel, J.G.; Gray, R.W. (Inst of Gas Technol, Chicago, Ill). *Industrial Heating (Pittsburgh) ;* **47**: No. 11, 8-11(Nov 1980).

DOE has executed a contract with Memphis Light, Gas and Water Div. that requires MLGW to perform process analysis, design, procurement, construction, testing, operation and evaluation of a plant to demonstrate the feasibility of converting high-sulfur

bituminous coal to industrial fuel gas with a heating value of about 300 Btu/SCF. The demonstration plant will be based on the U-GAS Process of IGT, and its product gas is to be used in commercial applications in Memphis, Tennessee. The plant, to be located on the Mississippi River, will be designed to produce fuel gas, equivalent of 50 million cu ft of natural gas per day, from 3200 tons per day of Western Kentucky coal. The progress of the program is described.

34230 **Compatibility of water-cooled refractories with a basic coal-ash slag at 1500/degree/c.** Kennedy, C.R. (Argonne Natl Lab, Ill). *Journal of Materials for Energy Systems ;* **2**: No. 2, 11-20(Sep 1980).

Eleven refractories were investigated. The highest corrosion resistance was demonstrated by a fused-cast chrome-spinel refractory (80 pct Cr/sub 2/O/sub 3/). The addition of between 16 and 32 pct chromia to alumina refractories was sufficient to cause a dense spinel reaction product layer to form. Free MgO in magnesia-chrome magnesia-spinel refractories was quickly dissolved by the slag. High chromia content and density are important factors in limiting corrosion. 5 refs.

34231 **System of multiphase reactor models for the ASPEN process simulator and their applications to coal conversion reactors.** Espedal, M.L. (Texaco, Houston, TX); Britt, H.I.; Evans, L.B. *Coal Processing Technology ;* **6**: 223-225(1980).

ASPEN (Advanced System for Process Engineering) is a process simulator and economic evaluation system under development at the Massachusetts Institute of Technology. The development is supported by the US Department of Energy for use in engineering of fossil energy conversion processes. This paper describes the system of multiphase reactor models that has been developed for ASPEN. The system includes: (1) a nonstoichiometric (yield-based) model, (2) a stoichiometric (fractional conversion based) model, (3) a well stirred (CSTR) model, and (4) a plug flow model. All models can handle a vapor or liquid phase and solid phases with interphase reactions. In addition, the plug flow model is capable of treating both interphase heat transfer and heat transfer to an external coolant. The system also includes two other models not discussed in this paper. They involve single-phase or multiphase chemical equilibrium with a wide variety of specifications. It is recognized that the various mechanisms taking place in a reactor are often very complex and difficult, if not impossible, to generalize. Therefore, emphasis has been placed on the use of user-supplied FORTRAN subroutines for kinetics, heat transfer, and pressure drop models. The goals were to develop a system that is an advance over the reactor modeling capabilities of existing simulators and that is suitable for the modeling of fossil fuel conversion processes. It should be emphasized that ASPEN does not attempt to provide a set of detailed models for specific gasifiers or other reactors.

34232 **Heat transfer characteristics of two-phase flow through packed beds.** Holcombe, N.T.; Yavorsky, P.M.; Knickle, H.N. (DOE, Pittsburgh, Pa). pp 2107-2131 of Multiphase transport: fundamentals, reactor safety, applications (proceedings of the multi-phase flow and heat transfer symposium-workshop), 1979. Veziroglu, T.N. (ed.). Washington, DC; Hemisphere Publishing Corp. (1979).

From 2. multiphase flow and heat transfer symposium workshop; Miami Beach, FL, USA (16 Apr 1979).

The effective thermal conductivity (K/sub e/) and wall heat transfer coefficient (H/sub w/) were determined in a packed bed reactor model. Two flow regimes are described. The entrance effects for the low liquid flow regime seem to be limited to about ten diameters, while the entrance effects for the high liquid flow seem to extend the entire length of the column. 12 refs.

## 0106 Properties

*REFER ALSO TO CITATION(S) 34220, 34250, 34252, 35234*

34233 **(DOE/ET/13380—T1) Chemical modification and separation of preasphaltenes of SRC. Final report.** Woolsey, N.F.; Baltisberger, R.J. (North Dakota Univ., Grand Forks (USA)). Mar 1981. Contract FG22-78ET13380. 68p. NTIS, PC A04/MF A01. Order Number DE81030270.

Several preasphaltenes isolated from lignite and bituminous coal solvent refining products were acetylated with radio labelled acetic anhydride. This allowed determination of the hydroxyl content and increased solubility in common solvents. Gel permeation chromatography of the acetylated preasphaltenes gave 8 to 10 fractions for each sample which were characterized by their hydroxyl content, nmr parameters, combustion analysis and molecular weight determinations. The molecular weight varied from ca. 250 to 1000. The preasphaltene prepared at 480°C had the highest molecular weight average while the 400°C sample has the lowest. Detailed analysis of the data showed the lower molecular weight fractions had higher hydroxyl contents probably accounting for their inclusion in this solubility class. Generally nmr parameters and OH content did not vary much with molecular weight. Comparison to available asphaltene data showed a higher molecular weight for preasphaltenes as expected. The hydroxyl content, however, was about the same with about one OH group for every average molecule throughout the fractions of both asphaltene and preasphaltene samples. The most obvious difference besides molecular weight was in ether oxygen which was about twice as large for preasphaltenes. It was postulated that asphaltenes have fewer more flexible ethers than preasphaltenes. As part of our investigation we initiated studies on quantitative, selective ether cleavage reactions. Boron tribromide and trimethylsilyl iodide cleave dialiphatic and arylaliphatic ethers. Sodium in hexamethylphosphoric triamide (HMPA) was found to cleave arylaliphatic and diaryl ethers. Dibenzofurans were stable to the conditions developed. Preliminary application to preasphaltenes showed borontribromide and sodium/HMPA each cleaved 11 to 22% of the ethers present. This preliminary result is consistent with the above structural postulates.

34234 **(DOE/PC/30217—T2) Pyrolysis of coal-drived fuels using the laser-powered homogeneous pyrolysis technique. Technical progress report, August 5, 1980-July 31, 1981.** de Boer, P.C.T. (Cornell Univ., Ithaca, NY (USA)). 31 Jul 1981. Contract FG22-80PC30217. 19p. NTIS, PC A02/MF A01. Order Number DE82000251.

The progress made can be divided into two areas: theoretical work leading to an accurate computation of the temperature and velocity fields in the sample cell; and experimental work studying various chemical reactions involving hydrocarbons. The laser-powered homogeneous pyrolysis (LPHP) technique was applied to the unimolecular decomposition of 1,4-cyclohexadiene to benzene and hydrogen and of 1-chloropropane (n-propylchloride) to propene and hydrogen chloride as well as to the isomerization of cis-2-butene to trans-2-butent. These reactions proceed in different temperature ranges, with reaction rates that are well known. The temperature range covered is 575 to 850°K. The objective of this investigation was to establish proper operation of the LHLP technique over the temperature range of interest for the pyrolysis of coal-derived hydrocarbons. A set of equations was derived describing the motion of the strongly heated gas in the sample cell. The equations take account of the variations of viscosity and thermal conductivity with temperature, as well as of the dependence of the radiation absorption coefficient on temperature and density. A scheme was devised for the practical solution of these equations. A computer program has been written incorporating this scheme. Accurate measurements using the LPHP technique were made of various reactions proceeding in the temperature range 575 to 850°K.

34235 **(DOE/PC/30249—T2) Development of a thermodynamic properties correlation framework for the coal conversion industry. Phase IA. Annual report, September 1, 1980-August 31, 1981.** Starling, K.E.; Lee, L.L.; Kumar, K.H. (Oklahoma Univ., Norman (USA). School of Chemical Engineering and Materials Science). 1981. Contract FG22-80PC30249. 33p. NTIS, PC A03/MF A01. Order Number DE81030363.

A three-parameter corresponding states framework developed originally for light hydrocarbons has been modified to rapidly

develop a practical thermodynamic properties prediction capability for the coal conversion industry. The three-parameter corresponding states correlation is shown to accurately describe the thermodynamic behavior of pure non-polar and slightly polar non-associating coal fluids and mixtures for which the mixture constituents are known. Characterization techniques are outlined for converting distillation analysis of undefined mixtures (with composition available in terms of broad fractions) into representative pseudo-components. Empirical correlations have been developed to estimate the three correlations have been developed to esitmate the three corresponding states characterization parameters for each fraction from measurements made on the fraction (boiling point, specific gravity, molecular weight). Extension of the three-parameter corresponding states framework to a multiparameter framework to predict the thermodynamic behavior of polar and associating pure coal fluids is presently being persued. Interim results for one and two ring polar and associating coal fluids indicate that an extension of the corresponding states methodology to associating fluids using a five-parameter correlation is possible.

34236 **(DOE/PC/30293—3) Effects of preignition on pulverized coal combustion. Third quarterly report, 1 April 1981-30 June 1981.** Simons, G.A.; Kothandaraman, G. (Physical Sciences, Inc., Woburn, MA (USA)). Sep 1981. Contract AC22-80PC30293. 66p. NTIS, PC A04/MF A01. Order Number DE81030170.

A continuous branching description of the pore tree has been developed. The pores branch in a continuous downsizing manner. The theory predicts that the total surface area of each tree may be several orders of magnitude greater than the surface area of the tree trunk. The total volume of the pore tree may be one order of magnitude greater than that of the trunk and the total height of the tree may be as much as 30 times the trunk diameter. All expressions for the size and shape of the pore tree reduce to that describing a single isolated pore in the limit that the trunk radius approaches the minimum pore radius. While the above description of the pore tree is consistent with the actual structure of a common shade tree, the features of the pore tree may best be verified through its transport properties. Char oxidation is shown to be sensitive to the structure of the pore tree. The continuous branching model developed herein accurately reproduces the kinetic and diffusion solutions which were utilized in developing the transport model. The validation of the transport model in describing char oxidation indirectly verifies the continuous branching description of the pore tree. The current description of the pore tree provides a realistic pore structure in which pore evolution and species transport during pyrolysis may be assessed. It is anticipated that such a theory may be used to assess the secondary chemistry which occurs during pyrolysis. These important potential functions of the pore tree model are under current investigation.

34237 **(ORNL/MIT—334) Measurement of thermal conductivities in coal fluids.** Chang, C.S.; Bader, J.B.; Plawsky, J.L. (Oak Ridge National Lab., TN (USA); Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice). Sep 1981. Contract W-7405-ENG-26. 52p. NTIS, PC A04/MF A01. Order Number DE82000523.

As a qualification of a transient hot-wire thermal-conductivity cell for use on the Coal Liquids Flow System, the thermal conductivity of toluene was measured between 25 and 85°C. Static measurements over a 4-sec time span yielded a thermal conductivity at 25°C of 0.12607 W/m-K and a slope of thermal conductivity vs temperature of -0.2728 x $10^{-3}$ W/m-$K^2$. All results are within 2 to 5% of the most recent literature data. An experimental error analysis showed all errors to be less than 1% for the measurements of this study. Dynamic-mode measurements in which flow through the cell was interrupted only for the measurement period agreed within experimental accuracy with the static-mode measurements, demonstrating that the hot-wire cell is immediately applicable to coal-slurry thermal-conductivity measurements in the Coal Liquids Flow System. Sedimentation experiments showed that settling should have a negligible effect on thermal-conductivity measurements over the time period envisioned for measurement. Excellent agreement was obtained between previous measurements of thermal conductivities of coal slurries and the previous measurements of thermal conductivities of coal slurries and the predictions of the Rayleigh equation for heterogeneous-mixture thermal conductivities.

## 0108 Waste Management

*REFER ALSO TO CITATION(S) 34245, 34692, 35252, 35425*

34238 **Dry FGD system: the latest technology in flue-gas desulfurization.** Showers, G.M. Cincinnati, OH; Camargo Associates, Limited (1981). 16p. (CONF-8104107—3).

From 20. annual Kentucky industrial coal conference; Lexington, KY, USA (29 Apr 1981).

The focus of this paper is dry flue gas desulfurization; an overview and introduction to the state of current technology. This paper will present information gathered from the designers and manufacturers, as well as the owners and operators of dry flue gas desulfurization (FGD) systems. Also presented will be the theory, technical description, and general cost information for an industrial size FGD system. Information is included on the background and operating experience of current systems. In brief, in the dry FGD system, an alkali absorbent is sprayed into the flue gas stream as a solution or slurry. The moisture in the solution or slurry is evaporated by the heat of the flue gas while the sulfur oxide removal reaction is taking place. The result is a dry powder which is removed from the flue gas stream along with the boiler flyash.

34239 **(LBL—11758) Thermodynamic data for flue-gas desulfurization processes.** Brewer, L. (Lawrence Berkeley Lab., CA (USA)). Aug 1981. Contract W-7405-ENG-48. 56p. (CONF-801176—1). NTIS, PC A04/MF A01. Order Number DE81030545.

From Flue-gas desulfurization conference; Morgantown, WV, USA (6 Nov 1980).

The efficient design of processes for removal of sulfur dioxide resulting from coal and oil combustion requires thermodynamic and kinetic data for the various materials that might be used in the processes. Examination of the available thermodynamic data for sulfur compounds indicates serious uncertainties and a complete review is planned to provide the best set of internally consistent values obtainable from the literature and from current experiments. Although the main emphasis will be on information needed for aqueous limestone or lime slurry treatment, the data could also be used for other processes covering a wider temperature range. Thus it is planned to provide the data, when possible, for the range from room temperature to at least 1000K. The present compilation covers most of the materials that might play a role in $SO_2$ extraction processes and for which data were found. Supplements will be issued as data are obtained for additional substances of interest.

34240 (LBL—11983, pp 3.29-3.33) **Reactions of sulfite and nitrite ions in aqueous solutions.** Chang, S.G.; Littlejohn, D. Mar 1981. NTIS, PC A03/MF A01. Order Number DE81030532.

In Chemical process research and development program, FY 1980.

Lime/limestone scrubbers represent the current generation of technology for power plant flue gas desulfurization (FGD). The important chemical reactions that take place after dissolution of flue gas in an aqueous lime and limestone slurry must be identified so that a scrubber with better performance and reliability can be constructed. Because power plant flue gas contains hundreds of ppM of both $SO_2$ and NO/sub x/, it is essential to understand the chemistry between $SO_2$ and NO/sub x/ in aqueous solutions. This scientific understanding could also aid the development of a wet simultaneous desulfurization and denitrification process based on the addition of reagents and additives to the existing lime or limestone FGD scrubbers. Many concurrent and consecutive chemical reactions can occur as a result of the interaction between NO/sub x/ and $SO_2$ in liquid water. Nitrous (III) and nitric (IV) acids are produced in the aqueous phase after NO/sub x/ are absorbed into liquid water, and sulfite/bisulfite ions (IV) are formed if $SO_2$ dissolves in water. The kinetic studies of reactions that can take place as a result of interactions between sulfite/bisulfite and nitrite ions have been examined and the concentration profile of species produced in this system as a function of reaction time has been calculated.

34241 (LBL—11983, pp 3.33) **Absorption of NO by $Fe^{+2}$.NTA solution.** Demyanovich, R.J.; Lynn, S. Mar 1981. NTIS, PC A03/MF A01. Order Number DE81030532.

In Chemical process research and development program, FY 1980.

Work in Japan has shown ferrous ion complexed with ethylenediaminetetraacetic acid (EDTA) to be an effective absorbent for NO. Nitrilotriacetic acid (NTA) is less expensive than EDTA and has been shown in previous work to be effective as a buffer for absorbing $SO_2$, as a catalyst for the reaction between $O_2$ and ferrous ion, and as a chelating agent for both $Fe^{+2}$ and $Fe^{+3}$. The present work is investigating the absorption of NO and $SO_2$ by $Fe^{+2}$.NTA solutions.

34242 (LBL—11983, pp 3.34-3.38) **Processing of condensate waters from coal conversion.** King, C.J.; Mohr, D.; Hill, J.; Mackenzie, P.; MacGlashan, J. Mar 1981. NTIS, PC A03/MF A01. Order Number DE81030532.

In Chemical process research and development program, FY 1980.

Coal-gasification and coal-liquefaction processes produce large volumes of condensate water, formed from reactor effluents as they are cooled. The purpose of this project is to develop solely physicochemical processing methods that will enable recycle of the process condensate waters as cooling-tower make-up. This leads toward process configurations which will build up large concentrations of contaminants in condensate waters before the water is processed, as opposed to the dilution of these waters which is sometimes practiced for biological treatment. A typical physicochemical processing scheme might involve solvent extraction and stripping, followed by carbon adsorption or ozonation, as necessary to provide sufficiently complete removal of problem organics. Work to date has focused on four different areas - analysis of individual constituents of typical condensate waters, extraction with novel solvents which will allow more complete COD removal, interpretation of rates of stripping $NH_3$, $CO_2$, and $H_2S$ from samples of real condensate waters, and innovative combinations of extractions and stripping which can substantially decrease the energy consumption required for removal and recovery of ammonia.

34243 (ORNL/MIT—332) **Kinetics of wet oxidation of biological sludges from coal-conversion wastewater treatment.** Helling, R.K.; Strobel, M.K.; Torres, R.J. (Oak Ridge National Lab., TN (USA); Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice). Sep 1981. Contract W-7405-ENG-26. 55p. NTIS, PC A04/MF A01. Order Number DE82000525.

Combustible organics in aqueous solutions or suspensions, which are characteristic of waste treatment effluent from coal liquefaction, may be treatable by wet oxidation. The wet oxidation of model compounds (phenol in water or phenol in municipal waste sludge) in a batch autoclave reactor was found to proceed rapidly to 99% conversion in less than 15 min for temperatures between 185 and 230°C, oxygen pressures between 2000 and 1300 psig, and initial phenol concentrations of 2.5, 10, and 50 g/L. At 10 g/L initial concentration, the reaction rate was independent of the stirring rate, indicating that mass-transfer limitations were unimportant. The reaction occurs in three phases: a slow induction period, a fast first-order reaction with a low activation energy of 4.9 kcal/gmol, followed by a slow first-order reaction. During the reaction a variety of colored intermediates (catechol, succinic acid, hydroquinine) form. It is postulated that the fast portion of the reaction sequence follows free-radical mechanism. Solids settling and turbidity prevented accurate analytical analysis of the phenol in sludge samples, although qualitative results indicate that the disappearance of phenol follows a path similar to that in the phenol-water system.

34244 (ORNL/TM—7787) **Control of hydrocarbons and carbon monoxide via catalytic incineration.** Brown, C.H. Jr.; Klein, J.A. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 113p. NTIS, PC A06/MF A01. Order Number DE82000508.

Eight commercially available incineration catalysts were evaluated experimentally to assess their application to control hydrocarbon and carbon monoxide emissions in the tail gases from a Lurgi substitute natural gas plant, which were simulated using bottled gas mixtures. Catalysts were evaluated with respect to the effects of temperature, space velocity, and the presence of hydrogen sulfide and carbonyl sulfide on hydrocarbon and carbon monoxide conversion. Results indicate that within the scope of this study the most effective catalysts are a precious-metal-based catalyst on a monolithic substrate and a nonprecious metal oxide deposited on a solid substrate formed into 3.2-mm-diam spheres.

## 0109 Environmental Aspects

*REFER ALSO TO CITATION(S) 34693, 35415, 35416, 35423, 35428*

34245 (ANL/LRP—12) **Land Reclamation Program. Annual report.** Carter, R.P. (Argonne National Lab., IL (USA)). May 1981. Contract W-31-109-ENG-38. 110p. NTIS, PC A06/MF A01. Order Number DE82000171.

The primary objectives of this program are: (1) to develop energy-efficient and cost-effective mining and reclamation techniques; (2) to assist industry in evaluating the viability of environmental regulations and demonstrating techniques to meet these regulations; and (3) to supply data and evaluation techniques to decisionmakers concerned with trade-offs between energy development and environmental quality. Six integrated field research sites have been established to address problems associated with surface mining operations. The program relies heavily on input from industry and has developed working arrangements with coal companies at each of the current mining sites. A major area of interest is the continuing development of a DOE ten-year environmental mining and reclamation research plan. The Land Reclamation Program assigns the highest priority to the transfer of information generated by its research to appropriate users.

34246 (CONF-810909—8) **Environmental impacts associated with using peat for energy.** Reed, R.M.; Voorhees, L.D.; Mulholland, P.J. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 12p. NTIS, PC A02/MF A01. Order Number DE81032000.

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

Peat is an attractive energy alternative in the north-central states and on the southeastern coastal plain because: (a) it provides an indigenous supply of energy; (b) it is found in surface deposits and therefore can be easily mined; (c) the technologies to convert peat to useable energy are either proven or appear to be feasible; and (d) attractive possibilities exist for converting mined peatlands to productive agricultural or silvicultural use. The major environmental constraints associated with development of peatlands are related to disruption of important regional wetland ecosystems in terms of (a) ground and surface water hydrology; (b) water and air quality; (c) critical habitat for species of limited distribution; and (d) unique ecosystems that have important scientific and educational values. Development of peat resources for energy can be accomplished in an environmentally acceptable manner but will require detailed environmental planning and evaluation of these important regional ecosystems.

34247 (EPRI—202) **Environmental effects of trace elements in the pond disposal of ash and flue gas desulfurization sludge. Final report.** Holland, W.F.; Wilde, K.A.; Parr, J.L.; Lowell, P.S.; Pohler, R.F. (Radian Corp., Austin, TX (USA)). Sep 1975. 409p. NTIS, PC A18/MF A01. Order Number DE82900114.

The disposal of solid wastes from coal-fired electric generating stations was investigated from the standpoint of trace element contamination of ground waters. Coal ash and lime/limestone flue gas desulfurization sludge are commonly disposed of by ponding. The trace elements entering the generating station in the coal will leave the station primarily in the ash and sludge. Contact with water in a disposal pond will solubilize the trace elements and if pond leakage occurs, present a potential problem with groundwater contamination. Actual samples of ash and sludge from five operating generating stations were exposed to leaching conditions to simulate ponding. The levels of the dissolved trace elements were in general low, near the analytical detection limit. Selenium, chromium, boron, and, in isolated instances, mercury and barium exceeded the proposed EPA Public Water Supply Guidelines.

Water leaking from a pond will pass through a soil layer before mixing with ground waters. A series of batch and column tests using ash and sludge leachate in contact with natural soils was used to determine the degree of removal of trace elements in pond subsoil. Passage of pond effluent through soil was found to provide significant protection against ground-water contamination by trace elements.

34248 **(EPRI-EA—2039) Environmental impacts of energy transportation. Final report.** Price, J.P.; Limaye, D.R.; Ciliano, R. (Mathtech, Inc., Princeton, NJ (USA)). Sep 1981. 243p. NTIS, PC A11/MF A01. Order Number DE82900316.

This report presents the results of a review and synthesis of existing knowledge about the environmental impacts of fuel transportation for the electric utility industry. Emphasis is placed on the transportation of coal, but oil, natural gas liquified natural gas methanol, and hydrogen are also covered. The major identified impacts associated with coal unit trains are the physical barriers they create, potential accidents, and noise. The former two impacts are regarded as solvable, but the noise problem is far more intractable. Other modes of coal transport generate other types of environmental concerns. Coal slurry pipeline problems are related to water requirements and disposal. Truck transportation of coal leads to increased road and bridge deterioration and needs for repair. The approach in this study was to utilize a consistent and systematic framework to assess existing studies comparatively and to identify research gaps. The results of the study indicate that, except for a number of spectacular projects which have aroused considerable concern, little effort has been dedicated to the evaluation of the environmental socio-economic impacts of fuel transportation. While much of the existing work is useful, there are significant requirements for further research.

## 0110 Reserves And Exploration

34249 **(CSIRO—6) Survey into the application of geophysics in the Australian coal-mining industry.** Price, G.P. (Commonwealth Scientific and Industrial Research Organization, Mount Waverley (Australia). Div. of Applied Geomechanics). Jun 1978. 59p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE81904105.

The results of two surveys are presented. The first survey was conducted among geophysical groups within Australia who are involved in coal mining geophysics. Each group was asked to describe the techniques employed by them, emphasizing any research or experimental aspects. The second survey was conducted among coal mining companies and was aimed at the degree of reliance placed on geophysical techniques in solving mining problems. The results of the two surveys indicated a difference in attitude between the two industries. The potential of various geophysical techniques in confronting and solving coal mining problems is discussed.

34250 **(DOE/EV/10414—T1) Development of peatlands in northern Minnesota. Technical progress report.** Wright, H.E. Jq. (Minnesota Univ., Minneapolis (USA). Limnological Research Center). Sep 1981. Contract AC02-80EV10414. 5p. NTIS, PC A02/MF A01. Order Number DE82000873.

The extensive peatlands in northern Minnesota, larger than those of any other state except Alaska, are being seriously considered as an energy resource through the development of a gasification operation, and a feasibility study funded by DOE is in progress. The Minnesota Department of Natural Resources has undertaken studies on problems of peat mining, draining, reclamation, economic impact, wildlife, and vegetation. The present proposal is directed toward investigating the history of formation of the major peatlands in northern Minnesota, so that their distribution and composition can be more clearly related to the modern and past climate and to the various natural factors and processes prevailing in the region today and in the past. Particular attention will be paid to the formation of vegetation patterns that seem to be unique for North American peatlands, to regional differences from east to west that may reflect trends in postglacial climate and forest composition, to rates of peat formation in different environmental settings, and to the record of atmospheric pollution (industrial contaminations, agricultural dust) that may be contained in short cores of peat.

34251 **(DOE/FC/14690—T1) Peat resource evaluation: State of Maine. Report for the quarter ending August 1981.** Davis, J.; Anderson, W. (Maine Office of Energy Resources, Augusta (USA)). 1981. Contract FG18-79FC14690. 7p. NTIS, PC A02/MF A01. Order Number DE82000227.

The DOE/Maine Peat Resources Evaluation Program has been undertaken to determine the amount and location of fuel-grade peat that may be harvested and utilized in an environmentally acceptable manner in Maine. The resources inventory will provide a detailed evaluation of the peat deposits including maps showing areal extent, thickness, and distribution of peat, stratigraphic cross sections, and surficial mapping. Many deposits visited by earlier investigators had to be re-visited to more accurately assess the physical characteristics of the deposits and to obtain laboratory samples. Representative samples from surveyed deposits are obtained through standard field sampling techniques.

34252 **(DOE/PC/30013—5) Data base for the analysis of compositional characteristics of coal seams and macerals. Quarterly technical progress report, February-April 1981.** Davis, A.; Suhr, N.H.; Spackman, W.; Painter, P.C.; Walker, P.L.; Given, P.H. (Pennsylvania State Univ., University Park (USA). Coal Research Section). Aug 1981. Contract AC22-80PC30013. 96p. NTIS, PC A05/MF A01. Order Number DE81031977.

The first objective of the program is to understand the systematic relationships between the properties of coals and the second is to determine the nature of lateral and vertical variability in the properties of a single seam. Four coal samples showed significant decrease in calorific value during storage over a two-year period; the lower the calorific value and the higher the moisture of the samples, the greater was the decrease. Ninety-three coal samples and 454 selected printouts of coal data were provided on request to the coal research community. Maceral analysis of 5-cm subsections of column samples of the Lower Kittanning seam reveal some differences in the profiles of the seam collected from two different environmental settings. General trends in carbon, hydrogen, oxygen and nitrogen contents of the Lower Kittanning seam of western Pennsylvania are presented. Comparison to previously reported areal variability of seam thickness, ash, sulfur, volatile matter yield and vitrinite reflectance for the same seam is made. Controls of sedimentation and rates of coalification are discussed in relation to the areal variability which has been observed. Studies were made on the effects of oxidation during storage on the thermoplastic properties of coal, including the influence of particle size and different methods of storage. Reflectance analysis of 24 vitrinite concentrates at different wavelengths in the visible region has been completed. Plots of out-of-plane bending modes derived from FTIR show a clear increase with increasing rank; however, no trends are discernible for aromatic and aliphatic GM stretching intensities. The results of sorption of methanol and water on several coals and macerals at 25°C using gravimetric and pycnometric techniques are reported.

## 0120 Mining

*REFER ALSO TO CITATION(S) 34263, 34269, 34279*

34253 **(CSIRO—1) Destressing techniques and their application for extraction of the Greta Seam in the Ellalong Area.** Lama, R.D. (Commonwealth Scientific and Industrial Research Organization, Mount Waverley (Australia). Div. of Applied Geomechanics). May 1978. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE81903803.

Various destressing techniques are reviewed in principle and the conditions of their aplicability to extraction of the Greta Seam are assessed. In the light of the general observations made during a visit to the Pelton Colliery in April, 1977, it is suggested that the method of destressing by working in the same seam could prove useful for the Greta Seam conditions. In the absence of any data on the mechanical properties of the area and the stress field, approximate calculations are made to predict the extent of the horizontal zone destressed by working in the same seam.

**34254 (DOE/ET/10023—3) Development of optimal terrace-pit coal-mining systems. Phase I report: March 1981.** (Kaiser Engineers, Oakland, CA (USA)). Mar 1981. Contract AC01-79ET10023. 264p. NTIS, PC A12/MF A01. Order Number DE82000079.

This is a report on Phase I of a proposed five-phase project to be performed with US Department of Energy support, entitled The Development of Optimal Terrace Pit Coal Mining Systems. Phase I of the project deals with design and economic analysis of terrace pit mining concepts for surface mining of coal and comparison of these systems with conventional mining scenarios. Phase I included the publication of DOE Report No. FE/10023-1, A Survey of Nine Surface Mines in North America, and No. FE/10023-2, Characterization of Seven United States Coal Regions. The latter report described coal regions with strippable reserves which include sites for the five hypothetical mining situations developed for this study. A total of eighteen terrace pit and conventional mining scenarios were developed for these mining situations. Each is described in this report and examined for technological and economic feasibility, including sensitivity to variations in elements of cost. For each region, scenarios are ranked on economic bases. An Appendix in two volumes includes a description and definition of computer methods, glossary of terms, review of surface mining regulations, bibliography, and computer spread sheets.

**34255 (DOE/ET/11268—14) Feasibility analysis of trench strip and auger mining. Summary report.** (Skelly and Loy, Harrisburg, PA (USA)). Jun 1981. Contract AC01-79ET11268. 209p. NTIS, PC A10/MF A01. Order Number DE81027557.

The objective of this study was to assess the feasibility of using Trench Strip and Auger Mining as a means to extract coal reserves which are presently considered uneconomical to mine or which would present undesirable environmental effects if extracted using conventional surface mining methods. The conclusion is that Trench Strip and Auger Mining, when used as a primary mining system, is a viable alternative to conventional surface mining. Economically, a savings in the selling price of at least $12 per ton (from $28 to $16) can be realized with this concept. Environmentally, the amount of surface area disturbed can be reduced to half, and the amount of overburden handled can be reduced to one-seventh that of a conventional mine. It was also discovered that the trench mine gave similar results on certain surface minable sites that are economically and environmentally sound. The project was divided into five tasks: (1) Review Previous Work on Augering and Highwall Mining Technology; (2) Examine Trench Excavation Procedures; (3) Evaluate Equipment Options; (4) Develop Comparative Analysis; and (5) Prepare Reports. The efforts required to complete each of these tasks are documented.

**34256 (DOE/ET/12514—T1) Evaluation of CAVIJET cavitating jets for cutting coal-associated rocks. Final technical report.** Conn, A.F.; Cohen, S.H.; Frederick, G.S. (Hydronautics, Inc., Laurel, MD (USA)). Apr 1980. Contract AC01-77ET12514. 146p. NTIS, PC A07/MF A01. Order Number DE82001197.

From the laboratory rock cutting tests conducted during this program, the feasibility of using the CAVIJET cavitating fluid jet method to cut coal-associated rocks has been demonstrated. The pressures required for cutting the sedimentary rocks which would typically be found adjacent to the coal seam, namely shales, limestones, and sandstones, are well below the 68.9 MPa (10,000 psi) of conventional portable water jet pump equipment. Thus, the concept of providing an assist to existing mechanical heading machines by the use of cavitating jets has been shown to be a practical possibility. However, because of the possibly very large differences that may exist between the erosivity of in situ versus laboratory rocks, further validation, as recommended below, should be considered.

**34257 (DOE/ET/12548—7) Report of activities of the advanced coal extraction systems definition project for the period 1979-1980.** Lavin, M.L.; Isenberg, L. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Aug 1981. Contract AI01-76ET12548. 222p. NTIS, PC A10/MF A01. Order Number DE81030891.

The primary focus of the Project during 1979-1980 was formulation of system level performance goals and the translation of these goals into conceptual design requirements. The overall performance goals, although presented as specific to the Central Appalachian resource, are general in all areas except mine size and regional geology. Five system performance areas were covered: production cost, miner safety and health, environmental impact, and coal conservation. During the latter portion of 1980, project attention turned to transformation into conceptual design requirements the previously identified opportunities to meet the systems requirements. The Central Appalachian coals were chosen as the focus of the early system definition work on the basis of a brief analysis. Preliminary estimates indicated substantial deposits of coal in the Gulf Coast and the Brooks Range region of Alaska. At the close of 1980, this resource study was in the midst of an in-depth analysis of substantial coal deposits within the five major coal provinces - Appalachia, the Interior, the Rocky Mountains, the Gulf Coast, and Alaska. Finally, the project launched a brief conceptual design activity in early 1979, and performed a broad survey of current R & D in underground mining technology. Subsequent work in the area of technology assessment focused on underground slurry transport.

**34258 (DOE/ET/14210—T1) Extensible bridge-conveyor concepts for coal-mine face haulage. Final technical report as of 21 April 1981.** Swain, J.C.; Thomas, D.L.; Mullen, E.C. (Battelle Columbus Labs., OH (USA)). 1981. Contract AC01-79ET14210. 87p. NTIS, PC A05/MF A01. Order Number DE81031974.

The objective of the work reported herein was to develop design concepts for extensible bridge conveyors which can be used in multiples to form a continuous haulage system. Consultation services were provided by Jeffrey Mining Machinery Division on mining technology and B.F. Goodrich Engineered Systems Division on conveyor belt technology. Additional information was gathered in a mine visit, during visits to conveyor manufacturers, and contacts with several component suppliers. From a group of 20 machinery arrangement concepts, three extensible conveyor approaches were selected and machinery arrangement and internal detail drawings were prepared for each. Two of the concepts are for a face haulage system in which separate nonconnected extensible conveyors are individually trammed into position to form a continuous haulage system. The third concept is for a connected extensible system similar to existing continuous face haulage systems but employing extensible rather than fixed-length bridges. Cost estimates were prepared for the three concepts. The concepts developed employ belt-type conveyors, however, chain-type conveyors were considered to be a viable alternative.

**34259 (DOE/FE/00080—1) Longwall data bank. First quarterly project status report, May 28-August 28, 1981.** (Bituminous Coal Research, Inc., Monroeville, PA (USA)). Sep 1981. Contract AC01-81FE00080. 16p. NTIS, PC A02/MF A01. Order Number DE81030271.

During the months June through August, a comprehensive literature search and index file were initiated; references from various abstract publications and indices were obtained; a microfiche reader-printer was purchased; and abstracts from selected R and D reports and articles were prepared. The longwall questionnaire was revised; a number of revised questionnaires were filled in with information from the original questionnaires and forwarded to companies for updating. In addition, new companies were requested to respond to the questionnaire.

**34260 Method of lining a vertical mine shaft with concrete.** Eklund, J. D.; Halter, J. M.; Moffat, R. B.; Rasmussen, D. E.; Sullivan, R. G. (to U S Department of Energy). US Patent 4,270,876. 2 Jun 1981. Filed date 27 Dec 1979. vp.

The apparatus includes a cylindrical retainer form spaced inwardly of the wall of the shaft by the desired thickness of the liner to be poured and having overlapping edges which seal against concrete flow but permit the form to be contracted to a smaller circumference after the liner has hardened and is selfsupporting. A curb ring extends downwardly and outwardly toward the shaft wall from the bottom of the retainer form to define the bottom surface of each poured liner section. An inflatable toroid forms a seal between the curb ring and the shaft wall. A form support gripper ring having gripper shoes laterally extendable under hydraulic

power to engage the shaft wall supports the retainer form, curb ring and liner until the newly poured liner section becomes self-supporting. Adjusting hydraulic cylinders permit the curb ring and retainer form to be properly aligned relative to the form support gripper ring. After a liner section is self-supporting, an advancing system advances the retainer form, curb ring and form support gripper ring toward a shaft boring machine above which the liner is being formed. The advancing system also provides correct horizontal alignment of the form support gripper ring.

34261 **New respirable dust regulations (30 CFR, Parts 71 and 90).** Arlington, VA; Mine Safety and Health Administration (1980). 20p.

On December 5, 1980, amendments to the procedures for respirable dust sampling at surface coal mines and surface areas of underground coal mines (30 CFR 71) were published in the Federal Register. Also published in the Federal Register on this same date, were amendments to the procedures for respirable dust sampling of miners with evidence of pneumoconiosis (30 CFR 90). These amendments are final rules and become effective on February 1, 1981. The attached written examination and performance criteria comprise the certification examination for respirable dust sampling. Examination items are selected based on identified critical elements necessary to perform the certified task. The certification examination will consists of two parts; a written examination and a performance evaluation. A combined minimum score of 80 points must be achieved to pass the examination. An individual cannot be certified with a score lower than 80 points. The examination can be rescheduled through the MSHA District Coordinator. The published examination may be taken home, studied, and practiced until the applicant is familiar with the appropriate responses and can perform the required activities. MSHA Training Center personnel are available for assistance.

34262 **Calculational modeling of explosive fracture and permeability enhancement.** Butkovich, T.R.; Burton, D.E.; Bryan, J.B. (Lawrence Livermore National Lab., CA). Contract W-7405-ENG-48. *Journal of Energy Resources Technology ;* **101**: No. 1, 28-33(Mar 1979).

From International joint petroleum mechanical engineering and pressure vessels and piping conference; Mexico City, MX (19 Sep 1976).

With its underground explosion computer codes SOC and TENSOR, the Lawrence Livermore Laboratory is developing a capability for computer code prediction of fracture intensity and permeability enhancement far from a free face. Because the codes calculate fracture and not permeability, one must relate experimental measurements to a calculable parameter for fracture. High-explosive experiments in a coal outcrop and a multiple-charge experiment in a coal seam were designed to provide the needed data. Fracture intensity observed around the explosion centers is shown to be related to a calculated damage parameter $\epsilon$/sub f/. This parameter is actually the total failure-induced deviatoric strain. Intrinsic permeability, determined from hydraulic conductivity and calculated from results from slug tests in wells near the explosion, correlates at least qualitatively with the calculated residual tensile-fracture porosity, $\pi$/sub f/. An important observation is that no tensile failure occurs for some distance from the explosion-formed cavity when spherical charges are employed, whereas, tensile failure occurs near the cavity wall when cylindrical charges are used. 16 references, 8 figures.

## 0130 Transport And Handling

*REFER ALSO TO CITATION(S) 34248*

34263 **(DOE/ET/12453—T1) Extensible bridge-conveyor concept development. Final technical report.** Swain, J.C.; Mullen, E.C. (Battelle Columbus Labs., OH (USA)). 21 Apr 1981. Contract AC01-77ET12453. 92p. NTIS, PC A05/MF A01. Order Number DE81031973.

Objective was to develop and evaluate the concept for the Connected Extensible System (CES), a mobile bridge type continuous haulage system which employs extensible rather than fixed-length bridges. Optimum applications for the CES were identified. Concepts were developed for the interfaces between system components and between the CES and the continuous miner and the room conveyor. Configurations were chosen for the CES which optimize system use in the applications identified. Cost estimates were prepared and general operating specifications were defined. Chain was selected as the preferred conveying element. A cost-effectiveness study was conducted by Pennsylvania State University under a subcontract. The CES appeared to be a logical choice over shuttle cars in low to medium seam mines and over conventional continuous haulage in seams up to 80 inches if 88% availability is obtained, and if typical entry and crosscut centerline distances are employed. Longer centerline distances imply clear advantages for the CES concept.

34264 **(DOE/PC/30076—T3) Project to develop and demonstrate methods to eliminate frozen-coal-handling problems. Status report IV.** (United Coal Co., Bristol, VA (USA)). Sep 1981. Contract AC22-80PC30076. 18p. NTIS, PC A02/MF A01. Order Number DE81030967.

A description is presented of an investigation leading to solutions to the frozen coal problems occurring during winter months. Tests will be carried out in a test facility to evaluate those engineering parameters essential to the design, development, and demonstration of the most effective, economical, and environmentally acceptable method for fracturing frozen coal. The tests carried out during the initial feasibility study will provide the data and optimal procedures necessary for the implementation of a field test program to verify the acceptability and to demonstrate the commercial feasibility of the most effective methods or systems. The costs and benefits that will accrue from the new technology will be determined. To accomplish the goal of finding acceptable solutions to frozen coal problems, it will be necessary to bring forth the best possible technology available to get the job done. In pursuit of this objective, United Coal Company has initiated a comprehensive survey and search to gather all known data and information relative to the subject of frozen coal, as well as methods - both mechanical and chemical - that have been employed to date in attacking the problem.

34265 **(ORNL—5736) Potential economic benefits from process control of coal preparation plants.** Bradley, N.C.; Allgood, G.O.; Moyers, J.C. (Oak Ridge National Lab., TN (USA)). Oct 1981. Contract W-7405-ENG-26. 55p. NTIS, PC A04/MF A01. Order Number DE82000881.

In practically all US coal preparation plants, the machines and instrumentation and control devices are manually operated to clean the run-of-the-mine coal of mud, rock, and other contaminants that are removed from the earth with the desired product. The result is a large loss of a valuable natural resource; for example, in 1978, 25 million tons of coal (valued at $600 million) were discarded as waste in 96 million tons of refuse from coal treatment plants. Since a maximum recovery of clean coal during initial processing of the run-of-the mine material is vital to the nation's energy conservation program, such a waste of good coal needs to be lessened. A maximum recovery of clean coal cannot be achieved by manual control of operations. Data from coal cleaning plants, which show a wide range of variation of the ash and sulfur contents in product steams and of the calorific value of refuse, support this conclusion. Based on 1978 production figures, 10 million tons of discarded coal could have been saved by on-line measurement and control techniques. Measurement sensors for on-line control of coal cleaning processes should be developed because there are no commercial, moderate-cost sensors of medium accuracy (5 to 10%) available for such applications. An expenditure of approximately $10 million to develop measurement sensors and process control techniques for coal preparation would be recovered by the conservation of coal. If the indirect value of the preservation of coal resources for future use, through reduced waste, is 1 cent per million Btu (a conservative estimate), the annual benefit based on 1978 production would equal $2 million.

34266 **Upgrading of lignite to enhance fuel value.** Baker, A.F.; McKeever, R.E.; Deurbrouck, A.W. (US DOE). *Mining Congress Journal ;* **67**: No. 4, 21-23, 26-29(Apr 1981).

A two-pronged program has been undertaken by the U.S. Department of Energy. The first part of the program is on the production of a lignite pellet with a moisture content of about 15 per-

cent and containing a binder which would provide good mechanical strength, seal the pellet surface against water absorption, reduce the danger of spontaneous combustion, minimize physical degradation, and improve the heating value. The second part of the program is the reduction of sodium content in lignites. 35 refs.

34267 **Method and apparatus for separating materials magnetically.** Hise, E.C. Jr.; Holman, A.S.; Friedlaender, F.J. (to Dept. of Energy). US Patent Application 204,450. 6 Nov 1980. 9p.

Magnetic and nonmagnetic materials are separated by passing stream thereof past coaxial current-carrying coils which produce a magnetic field wherein intensity varies sharply with distance radially of the axis of the coils.

34268 **Coal as a feedstock: producers capabilities.** Milliken, J.C. Lexington, KY; University of Kentucky (1980). 4p. (CONF-8004173—4).

From 19. annual Kentucky industrial coal conference; Lexington, KY, USA (30 Apr 1980).

The type of coal preparation plant to be built depends on the coal to be processed. By accumulating data either by sampling existing coal being mined or by testing boreholes at proposed mine sites and by examining the data several ways, by systems and size, it is possible to see what can be accomplished. If it's an easy to clean coal then it will be determined fairly quickly and easily that the coal can meet the requirements of the intended market. If it is not an easy coal to clean, or if its quality is marginal for an intended market, or if we desire to see just how good of a cleaning job is practical then we need to examine several cleaning schemes and review the various results. Even when the coal is easy to clean it should be reviewed this same wa to determine which method of cleaning gives the best yield. By comparing the various yields for different systems and checking the operating cost for the different systems we can determine which type of plant would make the best investment.

34269 **(DOE/ET/10038—T1) Build, field test, and evaluate a pneumatic hoist system (PHS) for the blind shaft borer (BSB). Final report.** (Radmark Engineering, Inc., Portland, OR (USA)). [nd]. Contract AC22-78ET10038. 139p. NTIS, PC A07/MF A01. Order Number DE81030374.

A vertical shaft sinking machine, the Blind Shaft Borer (BSB), is being developed, and this document reports on the development of a Pneumatic Hoist System (PHS) for use as a backup to the existing mechanical muck handling systems used on the BSB. A field test was conducted at the Bethlehem Steel Grace Mine near Morgantown, PA. Adaption of the PHS and the Vacuum Pickup System to the BSB is discussed and the costs (capital and operating) analyzed. (DLC)

## 0140 Combustion

*REFER ALSO TO CITATION(S) 34484, 34514, 34675, 34691, 34693, 35317, 35356, 35357, 35358, 35360*

34270 (DOE/ER/10044—T1, pp 17p, Attachment C) **Progress report on heat transfer in coal-ash slags.** Viskanta, R.; Incropera, F.P. 15 Jul 1981. NTIS, PC A15/MF A01. Order Number DE81025882.

In Progress report to the Department of Energy in support of basic energy and policy research.

The primary objective of the experimental program has been to design and fabricate a laboratory test facility for the study of heat transfer through coal-ash slag layers. A secondary objective has been to perform preliminary experiments to gain confidence in and to improve the operation of the system. At this point in time, the first of these objectives has been accomplished and the preliminary experiments are about to be performed. The specific tasks which have been accomplished include: (1) the selection and purchase of a furnace capable of operation up to 2300°F, (2) the development of mathematical models for the test cell thermal conditions, (3) the selection of high temperature materials and instrumentation for use in the construction and operation of the test cell, (4) the design and fabrication of the test cell, (5) the construction of a flow system to filter, regulate, and measure the cooling water flow, (6) the procurement and characterization of slag samples, and (7) the development of a heat flux gauge to measure the incident radiation on the slag surface. A brief description of the foregoing activities is included.

34271 **(DOE/PC/30213—T1) Coal combustion in high convective flows. Progress report, March 1, 1981-August 31, 1981.** Ragland, K.W. (Wisconsin Univ., Madison (USA). Dept. of Mechanical Engineering). 8 Sep 1981. Contract FG22-80PC30213. 6p. NTIS, PC A02/MF A01. Order Number DE81030391.

Fundamental data on ignition delay, volatile burn time, volatile reactivity, char burn time, char reactivity, aerodynamic drag, particle surface temperature, and internal porosity of burning coal particles are being obtained as a function of coal type, particle size, gas temperature, gas velocity and oxygen concentration. Simulation of conditions inside a furnace has been achieved in two tests rigs which have been constructed. In the first rig single coal particles 3 to 12 mm in diameter are suspended on a 0.02 mm diameter stainless steel wire which extends from an electronic balance into a 50 mm dia. tube containing flowing electrically heated gas. This setup extends the traditional thermogravimetric analysis to flowing systems. In the second rig coal particles are levitated freely in a 50 mm diam, diverging insulated quartz nozzle. To date 16 fixed particle test runs have been made-7 with a Kentucky bituminous coal, 3 with a Montana sub-bituminous and 6 with a Texas lignite. Gas temperatures ranged from 760 to 1140°K, flow rates from 2 to 11 scfm, gas-particle velocities from 1.8 to 10.4 m/s, and Reynolds Numbers from 100 to 1150. The reactivity of the coal particles during devolatilization and char burn was calculated from the slope of the mass versus time curve and using the initial external surface areas. For the levitated particle tests the reactivity can be calculated from the $CO_2$ and CO curves. The results of the reactivity calculations to date are summarized. The reactivity data will be used to develop a theory of coal combustion which includes mass transfer and kinetic effects.

34272 **(TVA/OP/EDT—81/52) Some chemically improved limestones on the basis of results from thermogravimetry for coal combustion.** Frazier, G.C.; Hoffmeister, G.; Harrison, C.P.; Grimm, U.; Blouin, G.M.; Lancaster, F.E. (Tennessee Valley Authority, Chattanocga (USA). Office of Power). Jun 1981. 488p. NTIS, PC A21/MF A01. Order Number DE81030119.

Work in combustion chemistry by the Division of Energy Demonstrations and Technology, Tennessee Valley Authority (TVA), was implemented in order to achieve some chemically improved limestones having technical and cost-saving advantages for potential utilization by the TVA project for fluidized-bed combustion (FBC). This compilation report describes the results via the following four sections: summary, conclusions, and recommendations; thermogravimetry (TG) for coal combustion and some chemically improved limestones; preparation of chemically improved limestone granules for fluid-bed combustion tests; and evaluation of the sulfur sorption properties of chemically improved limestones during fluidized-bed combustion.

34273 **Coal-feeding mechanism for a fluidized bed combustion chamber.** Gall, R. L. (to to Department of Energy). US Patent 4,270,469. 2 Jun 1981. Filed date 13 Aug 1979. vp.

The present invention is directed to a fuel-feeding mechanism for a fluidized bed combustor. In accordance with the present invention a perforated conveyor belt is utilized in place of the fixed grid normally disposed at the lower end of the fluidized bed combustion zone. The conveyor belt is fed with fuel, E.G. Coal, at one end thereof so that the air passing through the perforations dislodges the coal from the belt and feeds the coal into the fluidized zone in a substantially uniform manner.

34274 **Some results of the wetting and adherence of synthetic coal ash droplets on steel.** Moza, A.K.; Austin, L.G.; Tressler, R.E. (Pa State Univ, University Park). *Journal of Engineering for Power ;* **102**: No. 3, 679-683(Jul 1980).

When a pulverized coal particle is burned the mineral matter associated with the particle melts to form droplets of molten glass.

The large water tube boilers used for steam raising for power generation are commonly fired with pulverized coal, and the adherence of the droplets can form slag coatings in the hotter parts of the boiler furnace. Of particular concern is adherence in the upper region of the furnace at the screen tubes, since the accumulation of a large mass of fused slag which then breaks away and falls can seriously damage the bottom tubes. As part of a project concerned with various aspects of this problem, a laboratory test has been developed which is an indication of the ability of a molten droplet to adhere to a cooler substrate. This paper is a further report on results obtained with this test.

34275 **(DOE/ET/13383—T1) Final report on Grant No. DE-FG21-78ET13383.** Katz, J.L. (Clarkson Coll. of Tech., Potsdam, NY (USA)). [nd]. Contract FG21-78ET13383. 16p. NTIS, PC A02/MF A01. Order Number DE81029479.

Slag vaporization is a serious problem in high-temperature coal combustion and gasification processes. As the combustion or gasification gases cool on passage through process equipment, the slag will recondense, often with very deleterious effects. For example, in gasification processes even small concentration of slag vapors can result in poisoning of catalysts and fouling of heat exchanger tubes. The ultimate goal of this research program is to create an apparatus capable of studying the nucleation of the products found in high temperature coal gasification and combustion. Since real coal combustion is a very complicated process with many reaction species, an experimental design was chosen which will allow successively more complicated reactant streams to be used, yet which at every stage are quite realistic approximation to real processes. A multiported flat flame burner, was constructed for the study. Preliminary nucleation studies are described. (WHK)

## 0150 Marketing And Economics

*REFER ALSO TO CITATION(S) 34265, 34268, 34939, 34940, 34968, 34968*

34276 **(ORAU—186) Investigation of coal prices and mine productivity.** Baker, J.G.; Stevenson, W. (Oak Ridge Associated Universities, Inc., TN (USA)). Sep 1981. Contract AC05-76OR00033. 144p. NTIS, PC A07/MF A01. Order Number DE82000235.

This report examines the empirically established relationship between coal prices and mine productivity. Literature on this topic is critically reviewed, and a conceptual model using the neoclassical theory of the firm is developed. In addition, industry-structure arguments related to firm composition, producer concentration, and firm goals are explored. The conceptual models are tested using mine-level data from the 1970s. The major conclusion of the study is that the coal industry responds to price changes in a manner that is consistent with a competitive, dynamic industry, implying that the coal industry is utilizing limited productive resources (land, labor, capital, energy) in an efficient manner. Therefore, one would expect higher production costs and reduced productivity as the industry attempts to meet the increased demand for coal expressed in higher prices - hence, an inverse price-productivity relationship. Ways in which this relationship can be improved include reviewing regulations and enforcement procedures, improving labor relations, opening new low-cost reserves on public lands, and improving mining technology.

## 0160 Health And Safety

*REFER ALSO TO CITATION(S) 34261*

34277 **(DOE/PC/30098—T1) Development of testing procedures & bibliographic information relevant to the testing of solid wastes resulting from synthetic-fuels production. Technical progress report, December 30, 1980-March 31, 1981.** Smith, J.M.; Hanson, D.M. (Bioassay Systems Corp., Woburn, MA (USA)). Mar 1981. Contract AC22-80PC30098. 25p. NTIS, PC A02/MF A01. Order Number DE81030671.

This report describes the progress Bioassay Systems Corporation has made on DOE Contract DE-AC22-80PC 30098 since December 1980. The literature search and evaluation tasks have been completed. A bibliography has been prepared consisting of over 80 references. In addition to this a compendium of data detailing bioassays performed on synfuel products has been prepared. Sample preparation procedures and bioassay test batteries have been defined.

34278 **(DOE/PC/30098—T2) Development of testing procedures & bibliographic information relevant to the testing of solid wastes resulting from synthetic-fuels production. Technical progress report, April 1, 1981-June 30, 1981.** Smith, J.M.; Hanson, D.M. (Bioassay Systems Corp., Woburn, MA (USA)). Jun 1981. Contract AC22-80PC30098. 17p. NTIS, PC A02/MF A01. Order Number DE81030822.

This report describes the progress Bioassay Systems Corporation has made on DOE Contract DE-AC22-80PC 30098 since March 1981. The data tables outlining which bioassay procedures have been applied to various synfuel wastes have been finalized. Justification for each of the assays (Health and Ecological Effects) proposed in the test battery have been written. In addition, the extraction and assay schedules have been developed for Task 3.

34279 **Training manual for miners: follows MSHA's guide lines. Volume 2. surface mining.** Chironis, N.P. (ed.). New York, NY; McGraw-Hill, Inc. (1980). 151p. (NP—1904135).

This course supplement is designed to be used as a complete study guide for mine safety and health training, as required by the Mine Safety and Health Administration (MSHA). Each of the mandated topics is covered in detail sufficient to comply with all the requirements for training miners. Course material presentations are followed by comprehensive quizzes to aid the students in determining if they have comprehended the main learning objectives for that course. Correct answers for each question follow the quizzes.

## 0170 Legislation And Regulations

*REFER ALSO TO CITATION(S) 34261, 35168*

34280 **Independent contractor regulations.** Arlington, VA; Mine Safety and Health Administration (1980). 24p.

Effective immediately, the general policy of the Mine Safety and Health Administration (MSHA) is to issue citations and, where appropriate, orders to independent contractors for their violations of provisions of the Act, standards or regulations that are applicable to independent contractors. This general policy is based on the amended definition of operator in the Federal Mine Safety and Health Act of 1977 (Act), which includes independent contractors performing services or construction at mines. MSHA's general enforcement policy regarding independent contractors does not change the basic compliance responsibilities of production-operators. Production-operators are subject to all provisions of the Act, standards and regulations which are applicable to their mining operation. This overall compliance responsibility of production-operators includes assuring compliance with the standards and regulations which apply to the work being performed by independent contractors at the mine. As a result, independent contractors and production-operators both are responsible for compliance with the provisions of the Act, standards and regulations applicable to the work being performed by independent contractors. This overlapping compliance responsibility of independent contractors and production-operators means that there may be circumstances in which it is appropriate to issue citations or orders to both for a violation. Further details are given.

# 02 PETROLEUM

## 0203 Drilling And Production

*REFER ALSO TO CITATION(S) 34514, 34660, 34691, 35288*

**34281** (DOE/ER/10044—T1, pp 18p, Attachment H) **Emulsion stability in enhanced oil recovery: a proposal to the energy policy research and information program.** Franses, E.I. 15 Jul 1981. NTIS, PC A15/MF A01. Order Number DE81025882.

In Progress report to the Department of Energy in support of basic energy and policy research.

Understanding how to measure and control stability and structure of emulsions of oil and water are prime factors in designing enhanced oil recovery processes for maximizing production from existing reservoirs. Each 1% increase in recoverable oil represents 1 billion metric tons, about half the annual world consumption. The study will be undertaken to determine the key problem of emulsion stability and characterize emulsion microstructure quantitatively. Dielectric relaxation methods will be used which are being developed in two current NSF-funded projects for dispersions in general. Dielectric relaxation methods will be combined with traditional structural methods and with tensiometry and measurements of the electrical j-potential at the oil/water interface. Well-characterized oil/water/surfactant systems will be studied in parallel to understand the fundamentals and as well as systems of more direct practical importance. This research forms part of a long-range plan that should lead to important improvements in enhanced oil recovery technology.

**34282** **(DOE/SF/10762—T3) Field demonstration of the conventional steam-drive process with ancillary materials. Quarterly report, April-June 1980.** Alden, D.R.; Eson, R.L. (Petro-Lewis Corp., Denver, CO (USA); Chemical Oil Recovery Co., Bakersfield, CA (USA)). 7 Jul 1980. Contract FC03-79SF10762. 7p. NTIS, PC A02/MF A01. Order Number DE81026969.

Purpose was to continue to treat the four test patterns and begin the collection of production and monitoring data to determine the effectiveness of the specific tests as designed in earlier phases of the contract. The data collected under the monitoring phase of the demonstration includes, but is not limited to; individual production well data, pattern production data, producing temperatures, steam injection profiles, chemical tracer surveys, casing vent gas emissions and residual oil saturations in the six observation wells. Throughout the project this data will be collected, reduced and compared with other privately funded enhanced oil recovery projects to best determine the benefits obtained through the use of ancillary additives to the conventional steam drive process.

## 0204 Processing

**34283** **Selectivity of alumina-chromium catalysts in dehydrogenation of higher n-paraffins.** Timofeyeva, Ye.A.; Ivankovskii, V.E.; Isagulyants, G.V. *Petroleum Chemistry USSR (English Translation)* ; **20**: No. 1, 1-5(1980).

Translated from Neftekhimiya; 290: No. 1, 50-53(1980).

A study was made of the effect of adding lithium to alumina-chromium catalysts and coking on the selectivity of these catalysts in dehydrogenation of higher linear paraffinic hydrocarbons. When carrying out the reaction at atmospheric pressure lithium, in contrast with potassium, does not change the selectivity of catalysts according to mono-olefins (potassium reduces it), while on increasing pressure both lithium and potassium increase this selectivity. Under the conditions studied, coking of catalysts reduces selectivity with conversions of up to 14% and increases it with higher conversions.

**34284** **Activity and selectivity of ion-exchange forms of NaX zeolite and a $NiO-Al_2O_3-SiO_3$ catalyst in propylene conversion.** Kuznetsov, O.I.; Panchenkov, G.M.; Tolkacheva, I.Ye. (Inst. of Petrochemical and Gas Industry, Moscow, USSR). *Petroleum Chemistry USSR (English Translation)* ; **20**: No. 1, 39-44(1980).

Translated from Neftekhimiya; 20: No. 2, 200-203(1980).

A study was made of catalytic activity and selectivity of NaX zeolites with a variable content of $Ni^{2+}$ ions and $NiO-Al_2O_3-SiO_2$ type catalysts with different $Al_2O_3$ content in propylene conversion. Maximum catalytic activity is found in NiX (30%) (liquid product yield being 86%) and a $NiO-SiO_2-Al_2O_3$ catalyst containing 2% of $Al_2O_3$.

**34285** **Mechanism of catalytic cracking of hydrocarbons on zeolites.** Shakirova, L.Kh.; Pluzhnikova, M.F.; Tsybulevskii, A.M. (All-Union Scientific Research and Design Inst. for Processing Gases, Krasnodar, USSR). *Petroleum Chemistry USSR (English Translation)* ; **20**: No. 1, 45-54(1980).

Translated from Neftekhimiya; 20: No. 2, 229-236(1980).

The addition to cracked zeolite catalysts of metal of the VIII group increases its cracking activity without changing activity in hydrogen redistribution. Cracking n-heptane in hydrogen increases reaction rate on a CaY catalyst approximately 2.5-fold and on a Pt/CaY catalyst - 30-fold. Regularities observed in the behavior of zeolite and metal-zeolite catalysts may be explained satisfactorily by bifunctional mechanisms of sequential reactions of cracking and redistribution of hydrogen.

## 0206 Health And Safety

*REFER ALSO TO CITATION(S) 34302*

## 0207 Marketing And Economics

*REFER ALSO TO CITATION(S) 34306, 34499, 34939, 34940, 34968, 34971*

**34286** **(DOE/RG/10078—T1) Interim report for documentation of computer programs for crude oil profile analysis.** (Avante International Systems Corp., San Antonio, TX (USA)). [nd]. Contract AC01-79RG10078. 133p. NTIS, PC A07/MF A01. Order Number DE81029138.

This report is summarizing the findings and documenting the programs developed by Economic Regulatory Administration (ERA) for the Crude Oil Profile Analysis. Based on a variety of estimates and assumptions from different sources, ERA developed a series of computer programs which generate a 24-month projection of the crude oil production in each of the price categories. AVANTE International Systems Corporation is contracted to provide an organized documentation for all of these data base, assumptions, estimation rationale and computing procedures.

## 0208 Waste Management

*REFER ALSO TO CITATION(S) 34239*

**34287** **(DOE/EV/05596—T1) Membrane ultrafiltration of sulfonates and oil from micellar flooding wastewaters. Final report.** Dubey, S.; Perez, N.L.; Ramakrishnan, B.; Thompson, R.E. (Tulsa Univ., OK (USA)). Sep 1981. Contract AS05-77EV05596. 215p. NTIS, PC A10/MF A01. Order Number DE81029978.

Two membrane ultrafilters were tested with simulated micellar-flood wastewaters. The waters were brine containing oil, sulfonate, butyl alcohol, and polymer. Two sulfonates, one essentially oil-soluble and one essentially water-soluble, were used. The polymer used was polyacrylamide, except for a few runs done with xanthan gum. The membranes produced permeates containing very little oil, sulfonate or polymer. The butyl alcohol apparently passed through quantitatively. The cellulosic membrane tested was more effective than the polymeric membrane in that it gave better flux rates and was easier to clean when fouled. A field sample was run with the cellulosic membrane. The field sample contained crude-oil sulfonate which, unlike the commercial surfactants used in the simulated wastewaters, passed through the membrane almost quantitatively. Membrane ultrafiltration will not be of use in purifying water containing such sulfonates.

## 0209 Environmental Aspects

*REFER ALSO TO CITATION(S) 35459*

**34288** **(AD-A—088062) Performance tests of high-speed ZRV oil skimmer. Final report.** Breslin, M.K. (Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ (USA)). Jun 1980. 157p. (CG-D—42-80). NTIS. Order Number DE81904164.

A self-propelled catamaran oil skimmer developed by the USCG capable of recovering oil from a water's surface was tested at the US EPA Ohmsett facility. The skimmer employed an endless composite sorbent belt processed between the catamaran hulls to recover oil. The tests were designed to determine the effect that various parameters (skimmer speed, oil viscosity, oil thickness, wave conditions, etc.) have upon oil recovery performance. The skimmer was towed through oil slicks at various speeds in different wave conditions as it was operated to collect oil. The collected fluid was quantitatively analyzed to determine the device's oil-to-water recovery ratio (recovery efficiency), oil recovery rate and thoroughness of slick removal (throughput efficiency). The device proved capable of good throughput efficiency in all wave conditions (up to 0.7 m confused seas) at all the two speeds tested (1 to 6 knots). Throughput efficiencies of 80 to 90% in calm water were common with all the oils tested. The performance of the full-scale skimmer agreed well with the results from the smaller prototype tested in 1976. The successful development of this skimmer provides a significant advance in oil spill recovery capability and technology. The concept used in this oil skimmer can be employed at speeds greater than those tested. Two oil slick converging systems were tested with the skimmer to effectively double the sweep width of the skimmer. Additional tests were conducted to determine vessel resistance and motion in waves and to assess the build-dup of potentially explosive vapors within the oil recovery system.

## 0230 Properties

*REFER ALSO TO CITATION(S) 34294, 35161, 35166*

**34289 Effects of residual oil combustion products on basic refractories in glass melting furnace.** Wei, G.C.; Tennery, V.J. (Oak Ridge Natl Lab, Tenn). *Industrial Heating (Pittsburgh) ;* **48**: No. 4, 44-46(Apr 1981).

An analysis of basic refractories degraded by residual oil combustion products is presented. The findings associated with refractories in a glass tank melting furnace are summarized. Maximum service temperature for the chrome-magnesite refractory was in the range 1500-1600/degree/C (2800-2900/degree/F), while for the magnesite refractory it was about 1100/degree/C (2012/degree/F). In the case of chrome-magnesite bricks and high-MgO bricks used in the regenerator, increasing the chrome ore content and decreasing the silicate content in the refractory can give better resistance to the type of fuel oil impurity attack observed.

## 0240 Storage

**34290 (DOE/US/07151—T1) Oil content of sediments in the sump of a salt dome solution-mined cavern used for crude oil storage. Final report.** Niederhoff, P.; Giles, H.N. (PB-KBB, Inc., Houston, TX (USA); KBB, Inc., Washington, DC (USA); Kavernen Bau- und Betriebs, G.m.b.H., Hannover (Germany, F.R.)). Sep 1981. Contract AC01-78US07151. 47p. NTIS, PC A03/MF A01. Order Number DE81030848.

The studies reported herein were conducted to ascertain if petroleum hydrocarbons are likely to accumulate in the sump sediments of a salt dome solution cavern used for crude oil storage and, if so, which hydrocarbons and in what concentrations. Cavern K 117 at Etzel, West Germany was selected for sampling because considerable data were available pertaining to the cavern and its crude oil inventory as a result of earlier studies. Mineralogical analyses of the sump samples revealed that they predominantly consist of uncemented halite crystals, ranging up to several centimeters in length, with subordinate anhydrite, and traces of gypsum and clay. Some of the mineral particles are colorless and translucent, while others are noticeably contaminated with oil. The samples exuded a distinct petroleum odor. Gas chromatographic analysis of an evolved gas sample showed the presence of the normal-paraffins propane through octane. Gas chromatographic analyses of a solvent extract of the sediment showed hydrocarbon and sulfur-compound distributions typical of crude oil. An infrared spectrum of the extract was also characteristic of a weathered or topped crude oil. The hydrocarbon content of the sediment samples was determined to be 780 ppM on the basis of a tetrachloromethane extract. It is believed that the petroleum present in the sump sediments principally results from cavern workover operations involving the pulling and resetting of the brine tubing string. When the brine string is reset it fills with oil because a packer is not used. To displace this oil, river water is pumped down the tubing at a moderately high rate. During this flushing process, clay particles dispersed in the river water adsorb a film of oil. As the oil-filmed clay particles enter the brine in the cavern they electrolytically flocculate and oil is sedimented to the cavern sump.

**34291 (SAND—81-0978) Analysis and leak tests of wells for new solution mined caverns at the Bryan Mound DOE-SPR storage site.** Goin, K.L. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1981. Contract AC04-76DP00789. 60p. NTIS, PC A04/MF A01. Order Number DE82000244.

An analysis is presented of factors inportant to leak tests of wells to be used in developing solution mined caverns in salt domes. Results of leak tests of 30 wells are presented. Leak rates of 26 of the wells met the DOE leak rate criterion of no more than 100 barrels per year per cavern.

**34292 National strategic crude oil storage in the Weeks Island dome salt mine. Part I. Geotechnical evaluation.** Mahtab, M.A. (Acres American, Inc., Buffalo, NY); Lamb, D.W.; van Sambeek, L.L.; Gill, J.D. Contract FEA-1251-75. *Journal of Energy Resources Technology ;* **101**: No. 2, 82-86(Jun 1979).

From Energy technology conference; Houston, TX, USA (5 Nov 1978).

This paper, the first in a series of two, presents the results of a geotechnical evaluation of the Weeks Island dome salt mine. The purpose of the evaluation was to confirm the suitability of the underground facility for the long-term storage of crude oil under the Federal Energy Administration's Strategic Petroleum Reserve Program. The Weeks Island mine, currently operated by the Morton Salt Company, is located in a salt dome on the Gulf Coast south of New Iberia, Louisiana. The mine has two levels of workings, at depths of approximately 185 and 245 m (600 and 800 ft) with development by the room-and-pillar mining technique. Geologic features of interest within the mine include zones of vertical banding and folding, shear zones, and blowouts. Field testing indicated that the salt mass is, for all intents and purposes, impermeable. Brine and oil leaks and gas seeps were examined and thought to be localized phenomena that did not affect mine stability and should not affect crude oil containment. The 23-m- (75 ft.) high pillars are generally intact with minor to severe spalling, generally in older areas of the mine. The mine roof exhibits no signs of distress or failure. Based on the overall results of the geotechnical and rock mechanics evaluations, the existing salt mine facility at Weeks Island was certified as suitable for the long-term storage of crude oil. 5 references, 7 figures.

**34293 National strategic crude oil storage in the Weeks Island dome salt mine. Part II. Rock-mechanics evaluation.** van Sambeek, L.L. (RE/SPEC, Inc., Rapid City, SD); Hansen, F.D.; Gnirk, P.F.; Mahtab, M.A. (Texas Univ., Austin). *Journal of Energy Resources Technology ;* **101**: No. 2, 87-92(Jun 1979).

From Energy technology conference; Houston, TX, USA (5 Nov 1978).

This paper, the second in a series of two, presents the results of a rock mechanics evaluation of the Weeks Island dome salt mine. The purpose of the evaluation was to assess the structural stability of the old mine workings in conjunction with a proposed new deeper mine level during the use of the facility for the long-term storage of crude oil under the Federal Energy Administration's Strategic Petroleum Reserve Program. The scope of the work involved laboratory testing of the strength and deformational characteristics of the rock salt; determination of a minimum web (or sill) thickness between the old workings (within which crude oil would be stored) and a proposed new mine level development below; and assessment of the effects of crude oil emplacement and withdrawal on the mine stability, as related to both the old workings and the proposed new mine level development. The finite element results, wherein use was made of the strength and deformation properties of the salt from the laboratory tests, indicated that a minimum sill

thickness of 90 m (300 ft) should be maintained between the old mine workings and the new level development. Furthermore, the emplacement and withdrawal of crude oil from the old workings will have little influence on pillar and sill stabilities for the entire mine, including the proposed lower level development. The only noticeable effect could, perhaps, be obtained in the creep rate due to changing stress conditions. 5 references, 6 figures, 3 tables.

## 0250 Combustion

*REFER ALSO TO CITATION(S) 34289, 34464, 34465, 34466, 35105, 35125, 35126, 35127, 35128, 35317*

34294 **(DOE/NASA/0152—1) Catalytic combustion with incompletely vaporized residual fuel.** Rosfjord, T.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center; United Technologies Corp., East Hartford, CT (USA). Research Center). Mar 1981. Contract AI01-77ET10350. 67p. (NASA-CR—16516). NTIS, PC A04/MF A01. Order Number DE82000419.

An experimental program directed toward demonstrating efficient catalytic combustion of fuel-lean mixtures of residual fuel and air, and assessing the influence of incomplete fuel vaporization on the performance of a catalytic reactor has been conducted. A fuel injection system was designed to provide uniform catalytic reactor inlet properties and a controllable level of fuel vaporization. The reactor was a graded-cell device constructed from Corning MCB-12, zirconia-spinel substrate. The elements were catalyzed with a UOP noble metal, proprietary catalyst. The fuel preparation and catalytic reactor components were used in tests with No. 6 oil, No. 2 oil or blends of residual fuel (No. 6 oil or shale residual oil) and No. 2 oil. The several tests performed with No. 6 oil indicated that complete vaporization of the fuel would be required to achieve satisfactory catalytic operation. Tests were performed with blends of either No. 6 and No. 2 oil, or a shale residual oil and No. 2 in an attempt to determine a threshold level of the heavy constituent for satisfactory combustor operation. The results suggested that no level of No. 6 oil was conducive to satisfactory performance unless complete vaporization was achieved. Shale oil blends were identified which resulted in stable operation without bursts of luminous particles exiting the reactor. This fuel differed from the No. 6 oil by having a lower temperature final distillation point; that is, it did not contain the high molecular weight species contained in the No. 6 oil. Tests performed with the shale oil blends indicated that the combustor performance was sensitive to the degree of fuel vaporization. A similar effect was observed in tests performed with No. 2 oil.

34295 **(EPRI-CS—1995) Particulate emission characteristics of oil-fired urtility boilers.** Piper, B.F.; Hersh, S.; Mormile, D.J. (KVB, Inc., Elmsford, NY (USA); Consolidated Edison Co. of New York, Inc., New York (USA)). Aug 1981. 95p. NTIS, PC A05/MF A01. Order Number DE81904193.

The size distribution and composition of particulate emissions from three oil fired utility boilers were determined under representative nominal operating conditions. In addition, the variability of particulate size and compositional characteristics with changes in furnace excess air level and fuel atomization quality was obtained from one boiler as an indication of the fluctuations in particulate emissions which could be anticipated as a result of variable operating practices. The three test boilers included a 360 MW tangentially fired boiler, a 345 MW face fired boiler and a 150,000 lb/hr steam sendout package boiler - all burning a low sulfur (0.24%) fuel oil. The particulate emissions from the 360 MW tangentially fired boiler exhibited a submicron single mode size distribution with a number mean on the order of 0.05 microns. Reduction in excess air levels to the smoking threshold did not modify this distribution. However, reduction in the atomization quality of the fuel sprays resulted in a bi-modal distribution consisting of large (greater than 10 microns) porous particles in addition to the submicron population. Data from both the 345 MW face fired boiler and a 150,000 lb/hr steam sendout package boiler showed a bi-modal distribution under normal operating conditions. Particulate composition analyses demonstrated increases in carbon for both the reduced excess air and reduced atomization quality tests. Sulfate emissions were also found to increase for the atomization tests. Scanning Auger microprobe analysis combined with an argon ion milling technique indicated that this sulfate was found as a surface layer on the large carbonaceous particulates emitted under this operating condition.

# 03 NATURAL GAS

## 0301 Reserves

34296 **(MLM-MU—81-67-0008) Evaluation of resource-assessment values and in-situ combustion potential for the OH-4 and PA-3 wells. Final report.** Zielinski, R.E.; McIver, R.D. (Monsanto Research Corp., Miamisburg, OH (USA)). 24 Jul 1981. Contract AC04-76DP00053. 158p. (GRI—79-0110). NTIS, PC A08/MF A01. Order Number DE82000388.

The OH-4 and PA-3 wells provided the first direct comparison of resource assessment methods for estimating free hydrocarbon gas contents in the Devonian shales. For the first time, the pressure core barrel was successfully utilized in a shale formation. A comparison of the three methods of resource assessment indicated that the conventional method employed for most cored wells has provided a significantly conservative estimate of resource and has not provided any offgassing rate data. The pressure core barrel method provided the ultimate in gas resource values; however, the controlled offgassing method employed on these wells provided relevant data. Geochemical analysis of OH-4 and PA-3 samples indicated that the shale in this area is atypical of the Devonian Shale from other Appalachian wells. The shale in these wells is moderately immature and oil prone; however, it has significant hydrocarbon gas content. These characteristics indicate that this shale might be combustion. A conventional mud-logger employed during the drilling had serious shortcomings.

## 0302 Geology And Exploration

34297 **(DOE/METC—118) Evaluation of Devonian shale potential in New York.** (Tetra Tech, Inc., Columbus, OH (USA)). 1981. Contract AC21-79MC10389. 70p. NTIS, PC A04/MF A01. Order Number DE82001163.

This report is a brief overview of preliminary geologic interpretations developed from the Eastern Gas Shales Project (EGSP) and related data concerning the deposition of the black shale facies and generation of natural gas in the Devonian shale sequence. The intent is to suggest areas of potential shale gas accumulation that would be of interest to the producer as either a primary target or a dual completion possibility. In New York, historical stratigraphic as well as current EGSP work has established the Devonian clastic facies as the type section for eastern North America. The initial documented shale-gas well was drilled in 1821 near Fredonia, New York. Since then, numerous shale-gas wells and/or deeper wells with gas shows in the shale section have been reported in western and central New York. The EGSP has focused on documenting and more closely defining organic-rich, black shale facies to project potential favorable trends. The purpose of this report is to inform the general public and interested oil and gas operators about EGSP results as they pertain to the Devonian gas shales of the Appalachian basin in New York. Geologic data and interpretations are summarized, and areas where the accumulation of gas may be large enough to justify commercial production are outlined. Because the data presented in this report are generalized and not suitable for evaluation of specific sites for exploration, the reader should consult the various reports cited for more detail and discussion of the data, concepts, and interpretations presented.

34298 **(DOE/METC—119) Evaluation of the eastern gas shales in Pennsylvania.** (Tetra Tech, Inc., Columbus, OH (USA)). 1981. Contract AC21-79MC10389. 103p. NTIS, PC A06/MF A01. Order Number DE82001165.

To evaluate the potential of the Devonian shale as a source of natural gas, the US Department of Energy (DOE) has undertaken the Eastern Gas Shales Project (EGSP). The EGSP is designed not only to identify the resource, but also to test improved methods of inducing permeability to facilitate gas drainage, collection, and

production. The ultimate goal of this project is to increase the production of gas from the eastern shales through advanced exploration and exploitation techniques. The purpose of this report is to inform the general public and interested oil and gas operators about EGSP results as they pertain to the Devonian gas shales of the Appalachian basin in Pennsylvania. Geologic data and interpretations are summarized and areas where the accumulation of gas may be large enough to justify commercial production are outlined. Because the data presented in this report are generalized and not suitable for evaluation of specific sites for exploration, the reader should consult the various reports cited for more detail and discussion of the data, concepts, and interpretations presented.

34299 **(DOE/METC—121) Evaluation of Devonian shale potential in Eastern Kentucky/Tennessee.** (Tetra Tech, Inc., Columbus, OH (USA)). 1981. Contract AC21-79MC10389. 104p. NTIS, PC A06/MF A01. Order Number DE82001164.

To evaluate the potential of the Devonian shale as a source of natural gas, the US Department of Energy (DOE) has undertaken the Eastern Gas Shales Project (EGSP). The EGSP is designed not only to identify the resource, but also to test improved methods of inducing permeability to facilitate gas drainage, collection, and production. The ultimate goal of this project is to increase the production of gas from the eastern shales through advanced exploration and exploitation techniques. The purpose of this report is to inform the general public and interested oil and gas operators about EGSP results as they pertain to the Devonian gas shales of the Appalachian basin in eastern Kentucky and Tennessee. Geologic data and interpretations are summarized, and areas where the accumulation of gas may be large enough to justify commercial production are outlined.

34300 **(DOE/METC—122) Evaluation of Devonian-shale potential in Ohio.** (Tetra Tech, Inc., Columbus, OH (USA)). 1981. Contract AC21-79MC10389. 90p. NTIS, PC A05/MF A01. Order Number DE82001162.

The purpose of this report is to inform interested oil and gas operators about EGSP results as they pertain to the Devonian gas shales of the Appalachian basin in eastern Ohio. Geologic data and interpretations are summarized, and areas where the accumulation of gas may be large enough to justify commercial production are outlined. Because the data presented in this report are generalized and not suitable for evaluation of specific sites for exploration, the reader should consult the various reports cited for more detail and discussion of the data, concepts, and interpretations presented. A complete list of EGSP sponsored work pertinent to the Devonian shales in Ohio is contained as an appendix to this report. Radioactive shale zones are also mapped.

## 0303 Drilling, Production, And Processing

34301 **(DOE/MC/16823—T1) Integration, interpretation and evaluation of results in a multi-well interference test project. Quarterly financial summary and monthly technical report.** Alam, J. (Science Applications, Inc., Morgantown, WV (USA)). 8 Sep 1981. Contract AC21-78MC16823. 64p. NTIS, PC A04/MF A01. Order Number DE81030377.

The objectives of this project are to analyze interference test data in order to determine in situ flow properties of Devonian shale reservoirs. Preliminary analysis of build-up interference test data and drawdown test data for all the zones is summarized. The drawdown interference data have been analyzed in order to identify the matrix influence and quantify its properties which are then used in quantifying key parameters. Preliminary analysis of the interference test data indicates pseudo-steady state (quasi-steady-state) gas transport in the matrix. The approximate fracture storage coefficient and dimensionless fracture transfer coefficient from the bottom zone of well number 10056B were calculated as $10^{-1}$ to about $10^{-2}$, and 4.0 x $10^{-6}$, respectively.

## 0304 Products And By-products

*REFER ALSO TO CITATION(S) 35173*

## 0305 Health And Safety

34302 **(DOE/BETC—3000-1) Methods for determining vented volumes during gas-condensate and oil-well blowouts.** Hawkins, M.F. Jr. (Coastal Petroleum Associates, Baton Rouge, LA (USA)). Sep 1981. 44p. NTIS, PC A03/MF A01. Order Number DE81030779.

Several methods are presented for determining vented volumes during gas-condensate and oil well blowouts. Each method is illustrated with a numerical example. The method of crossplotting formation and flow string resistances is the only one which does not require special measurements. It is, therefore, applicable to cratered wells and underwater blowouts. The report includes several suggestions for investigations which might lead to better methods.

## 0306 Marketing And Economics

*REFER ALSO TO CITATION(S) 34939, 34941, 34968, 34972*

34303 **In our own backyard.** Mathews, L.A. pp 23-31 of Proceedings of third annual energy seminar. Erie, PA; Gannon University (1981).

From 3. annual energy seminar; Erie, PA, USA (31 Mar 1981).

National Fuel Gas Supply Corp. has five sources of gas supply to its 670,000 customers in western NY, northwestern PA, and a small section of eastern OH. A significant amount of its pipeline gas purchases during the summer months goes into underground storage. Each source of gas supply and its future are discussed, particularly local drilling of gas wells. (DLC)

## 0308 Environmental Effects

*REFER ALSO TO CITATION(S) 34248*

34304 **(FERC/EIS—0030D) Trans-Anadarko pipeline project: draft environmental impact statement.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Pipeline and Producer Regulation). Sep 1981. 251p. NTIS, PC A12/MF A01. Order Number DE82000486.

This draft environmental impact statement (DEIS) arises from an application for a certificate of public convenience and necessity authorizing the construction and operation of 635 miles of 36-inch diameter pipeline and appurtenant facilities between Moore County, Texas, and Ouachita Parish, Louisiana. As proposed, the facilities would be constructed in two phases. The DEIS assesses the environmental impact of the proposed project, recommended modifications to the proposed routing, and the feasibility of various alternatives including a system alternative. The environmental staff has examined the project's potential effects on soils, geology, water, land use, recreation, aesthetic qualities, air quality, noise levels, vegetation, wildlife, cultural resources, socioeconomics, and pipeline safety conditions. On the basis of information currently available, the environmental staff concludes that the construction and operation of the proposed project would have limited adverse environmental impact. However, further investigation of several system design or routing modifications which would reduce environmental impact is required, and several new concerns raised by the present investigation require that additional information be provided by Trans-Anadarko. The environmental staff also concludes pending further development of other considerations, that the Trailblazer Extension Alternative is environmentally superior and preferable to the proposed project. The staff recommends implementation of several mitigating measures as conditions to the certificate, should the Commission approve the project.

### 0309 Artificial Stimulation

**34305 (DOE/BC/10003—23) Western Gas Sands Project. Interim economic analysis of natural gas production from tight formations in selected western basins.** (CER Corp., Las Vegas, NV (USA); TRW Energy Systems Group, Redondo Beach, CA (USA)). Jul 1981. Contract AC08-79BC10003. 64p. NTIS, PC A04/MF A01. Order Number DE82000709.

The following are reported: economic analysis methodology, Wattenberg (Colorado) field data assessment, Washakie (Wyoming) Basin data assessment, and estimation of well performance using multiple regression analysis. (DLC)

**34306 (EPRI-EA—2023-SY) Assessment of emerging energy sources. Summary report.** (Booz-Allen and Hamilton, Inc., Bethesda, MD (USA). Energy and Environment Div.). Sep 1981. 43p. NTIS, PC A03/MF A01. Order Number DE82900318.

This report summarizes the results of a broad review and analysis of the commercialization potential for eight emerging sources of energy: tight gas sands; heavy oil; methane from geopressured aquifers; oil shale; enhanced oil recovery; advanced coal mining technologies; and underground coal gasification. Each source of energy or technology was evaluated with respect to six factors affecting commercialization: size and characteristics of resource; technical and economic performance; relevant energy market growth rates; logistical considerations; development lead times; and regulatory and institutional factors. The evaluation was based on a review of existing literature, extensive interviews with industry experts and Booz-Allen & Hamilton's overall assessment of the degree to which these factors would constrain commercial development. In addition estimates were made of supply potential from each emerging energy. This report summarizes Booz Allen's findings with respect to these factors.

**34307 (LA—8918-MS) Cottageville (Mount Alto) gas field, Jackson County, West Virginia: a case study of Devonian shale gas production.** Nuckols, E.B. (Los Alamos National Lab., NM (USA)). Aug 1981. Contract W-7405-ENG-36. 92p. NTIS, PC A05/MF A01. Order Number DE81032020.

Exploration and development of upper Devonian organic shales in the Cottageville gas field of western West Virginia began in the late 1920s. Continued development has led to the drilling of over 110 shale wells with accumulative production of more than 10 billion cubic feet of natural gas. Data indicate primary production from zones of organic shales in the lower part of the Huron Member of the Ohio Shale. Because of the extremely low porosity (3 to 4%) and permeability (less than 0.1 millidarcy) of these shales, gas production is considered to be through natural fracture systems. These fracture systems have been delineated through the study of oriented cores and the mapping of surface joints. Historically, production of gas has been through natural completion or by stimulation with gelled nitroglycerine. Varied success of this stimulation technique has recently led to more advanced types of stimulation (hydraulic and foam fracturing). Total production, natural gas-flow trends, final gas-flow trends, and structural breaks and trends have led to the delineation of the fractured-shale reservoir.

**34308 (UCRL—50036-81-1) LLNL gas-stimulation program. Semiannual progress report, October 1980-March 1981.** Hanson, M.E.; Anderson, G.D.; Shaffer, R.J. (Lawrence Livermore National Lab., CA (USA)). 9 Jun 1981. Contract W-7405-ENG-48. 52p. NTIS, PC A04/MF A01. Order Number DE82000802.

Preliminary theoretical and experimental analyses of fracture propagation in a nonuniform stress field have been performed. Results indicate fracture propagation is strongly influenced by existing stresses. A stress gradient in the existing stress field results in either the fracture stopping or, when over-driven, turning and propagating normal to the minimum stress. We have completed some preliminary analyses of fluid flow in apertures, and also characterized the mechanical properties of some of the core material from Mesaverde sandstones and shales from wells in Wyoming and Colorado. Our studies have continued to determine the feasibility of ultrasonic techniques in measuring in-situ stresses. Our effort has been directed toward developing a transducer package to test the measurements in a borehole, however, we have also concentrated on techniques to evaluate and interpret measurements. The effect of stress on velocity anisotropy has been shown in the laboratory, but the measurements are complicated by dynamic mode contamination. In our geologic studies we have continued to relate in-situ stresses to geologic structure, examining the effects of pore pressure increases on fracturing in the Green River Basin due to gas generation.

### 0320 Transport, Pipelines, And Handling

*REFER ALSO TO CITATION(S) 34248, 34304*

### 0340 Combustion

*REFER ALSO TO CITATION(S) 35317*

## 04 OIL SHALES AND TAR SANDS

### 0401 Reserves And Exploration

*REFER ALSO TO CITATION(S) 34296, 34297, 34298, 34299, 34300*

### 0404 Oil Production, Recovery, And Refining

**34309 (DOE/ET/13095—T1) Investigation of factors affecting the in-situ combustion retorting of oil shale. Final report.** Sohn, H.Y. (Utah Univ., Salt Lake City (USA). Coll. of Mines and Mineral Industries). 29 May 1981. Contract AS03-78ET13095. 166p. NTIS, PC A08/MF A01. Order Number DE82000482.

The objective of this research was to carry out an experimental and analytical investigation of a number of subprocesses taking place during an in situ combustion retorting of oil shale. Some of these subprocesses also occur in a surface retorting process. The specific topics of this research program include: (1) experimental determination of the intrinsic kinetics of kerogen decomposition producing oil; (2) mathematical formulation of the retorting of an oil shale block in the presence of heat transfer effects; (3) experimental determination of the intrinsic kinetics of oil shale char oxidation; (4) mathematical modeling of the oxidaton of oil shale char in a spent shale block in the presence of heat and mass transfer effects; (5) determination of ignition delay and energy requirements for the ignition of an oil shale bed; (6) determination of thermal expansion of oil shale; and (7) determination of heat capacities of oil shale and the heat of decomposition of kerogen. The results of the investigation of these topics are presented. Some of the results have been published in journals which are readily available. In such a case only a brief summary of the results are presented.

**34310 Effects of gas environment on mineral reactions in Colorado oil shale.** Burnham, A.K.; Stubblefield, C.T.; Campbell, J.H. (Lawrence Livermore Lab, Calif). *Fuel ;* **59**: No. 12, 871-877(Dec 1980).

The effects of various sweep gases (N/sub 2/, CO/sub 2/, and H/sub 2/O) on the decomposition and reaction of calcite and dolomite (ankerite) in Colorado oil shale is reported. Global reaction kinetics are developed that describe the rate of CO/sub 2/ evolution during decomposition of dolomite and calcite in the presence of various partial pressures of steam. Such data are useful in numerical models of oil shale retorting. 30 refs.

**34311 (UCID—19199) Design and test of a two-step solar oil-shale retort.** Gregg, D.W.; Taylor, R.W.; Aiman, W.R.; Ruiz, R. (Lawrence Livermore National Lab., CA (USA)). 24 Sep 1981. Contract W-7405-ENG-48. 35p. NTIS, PC A03/MF A01. Order Number DE82000964.

Solar retorting of oil shale has been identified as a technically feasible process where focused solar energy can displace fossil energy in the production of liquid fuels. The predicted result is a 10 to 40% improvement in the exportable fuel (oil + gas) production

per ton of raw shale. The degree of improvement depends strongly on the grade of the shale. Greater improvements can be achieved with the lower grade shales where with nonsolar processes a larger fraction of the fuel content has to be used in the processing. This report presents a design of a two-step solar oil shale retort, the logic for the design, and the results from a preliminary test of the design at the White Sands Solar Furnace, New Mexico. The tests showed that the basic design had considerable promise, but more development work would be needed to optimize it.

34312 **(UCID—19216) Oil shale Retort Run summary, Run C-4.** Christiansen, D.E.; Diaz, J.C. (Lawrence Livermore National Lab., CA (USA)). 2 Oct 1981. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01. Order Number DE82001054.

Retort Run C-4 comprised four combustion run segments in a continuous aboveground retort conducted June 23 through June 27, 1980. The shale was -2.5 + 1.3 cm (-1 + 1/2 in.) from Anvil Points. The retorting rates were 40 to 65 m/d (130 and 220 ft/d), and the feed gases were 30 and 40% air in steam for each of the retorting rates. The LLNL mathematical model of modified in-situ and aboveground retorting is capable of predicting the overall behavior of a settling bed retort even when operated at high linear shale rates. Settling-bed oil shale retorts can be operated on a small scale without internal equipment (such as air distributors) provided that there is sufficient instrumentation to determine what is happening in the retort and sufficient controls to adjust the various flow rates. Variation of retorting rate from 38 to 73 m/d had little effect upon the oil yield or properties.

### 0405 Properties And Composition

*REFER ALSO TO CITATION(S) 34294, 34309*

### 0406 Direct Uses And By-products

*REFER ALSO TO CITATION(S) 34678*

### 0407 Health And Safety

*REFER ALSO TO CITATION(S) 34277, 34278*

### 0408 Marketing And Economics

*REFER ALSO TO CITATION(S) 34306*

### 0410 Enviromental Aspects

34313 **(DOE/LC/10787—80) Meteorological and climatological investigation: review of January-June 1980 investigative period.** Lundberg, D.R.; Spradlin, H.K.L. (Geokinetics, Inc., Concord, CA (USA)). Jul 1981. Contract FC20-78LC10787. 81p. NTIS, PC A05/MF A01. Order Number DE81030740.

Since January 1979, a meteorological and climatological investigation for the purpose of establishing a microclimatic baseline has been continuously conducted at the Geokinetics oil shale research facility in Eastern Utah. This report, however, presents the findings for only a six month segment (January 1-June 30, 1980) of that ongoing investigation. Included in this report is a description of the program design, the handling and interpretation of the data, and program improvement considerations recommended for inclusion into future segments of the investigation.

34314 **(DOE/LC/10787—80-App.D-Vol.1) Meteorological and climatological investigation: review of January-June 1980 investigative report.** Lundberg, D.R.; Spradlin, H.K.L. (Geokinetics, Inc., Concord, CA (USA)). Jul 1981. Contract FC20-78LC10787. 170p. NTIS, PC A08/MF A01. Order Number DE81030741.

Since January 1979, a meteorological and climatological investigation for the purpose of establishing a microclimatic baseline has been continuously conducted at the Geokinetics oil shale research facility in Eastern Utah. This report, however, presents the findings for only a six month segment (January 1 - June 30, 1980) of that ongoing investigation. This appendix to the meteorological and climatological investigation contains the WestAq data printouts.

34315 **(DOE/LC/10787—80-App.D-Vol.2) Meteorological and climatological investigation: review of January-June 1980 investigative period.** Lundberg, D.R.; Spradlin, H.K.L. (Geokinetics, Inc., Concord, CA (USA)). Jul 1981. Contract FC20-78LC10787. 145p. NTIS, PC A07/MF A01. Order Number DE81030742.

Since January 1979, a meteorological and climatological investigation for the purpose of establishing a microclimatic baseline has been continuously conducted at the Geokinetics oil shale research facility in Eastern Utah. This report, however, presents the findings for only a six month segment (January 1-June 30, 1980) of that ongoing investigation. This appendix to the meteorological and climatological investigation contains the WestAq data printouts.

34316 **Enzyme activities in revegetated surface soil overlying spent Paraho Process oil shale.** Sorensen, D.L.; Klein, D.A.; Ruzzo, W.J.; Hersman, L.E. (Colorado State Univ., Fort Collins). Contract EY-76-S-02-4018. *Journal of Environmental Quality ;* **10**: No. 3, 369-371(Sep 1981).

Techniques for covering Paraho retorted oil shale with surface soil to allow more efficient revegetation have been evaluated for 2 years in the Piceance Basin of Colorado. In this study, several key microbiological parameters related to soil development and biogeochemical cycling processes were monitored to evaluate possible relationships between surface soil management and soil microbiological responses. Surface soil of 30-, 61-, and 91-cm depths placed directly over Paraho processed oil shale showed appreciable reduction in nitrogenase (acetylene reduction), dehydrogenase, and phosphatase activities as compared with surface soil not in contact with processed shale. The decreased nitrogenase and dehydrogenase activities in these soils placed directly over the processed shale at the various depths were not significantly different ($P \leqq 0.05$). With a 30-cm coarse rock capillary barrier between 61 cm of soil and the processed shale, the soil had nitrogenase and phosphatase activities which were not significantly lower ($P \leqq 0.05$) than the control soil. Interactive effects of seeding mixtures and fertilization on nitrogen fixation potential were also suggested, with introduced species plot soils not showing decreased nitrogen fixation potentials that were observed with the native species plots. These field results suggest that a capillary barrier may allow better maintenance of microbial processes in soils placed over Paraho retorted shale during revegetation.

## 05 NUCLEAR FUELS

### 0501 Reserves

*REFER ALSO TO CITATION(S) 34318*

### 0502 Exploration

*REFER ALSO TO CITATION(S) 34300, 35531*

34317 **(DPST—81-146-12) Washington $1^0$ x $2^0$ NTMS area Virginia and Maryland: data report (abbreviated). National uranium resource evaluation program, hydrogeochemical and stream sediment reconnaissance.** Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1981. Contract AC09-76SR00001. 18p. NTIS PCE02/MF A01. Order Number DE81030641.

Includes 7 sheets of 24x and 48x reduction microfiche.

This report summarizes results of ground water, surface water, and stream sediment reconnaissance in the National Topographic Map Series (NTMS) Washington $1^0$ x $2^0$ quadrangle. Surface sediment samples were collected at 729 sites. Ground water samples were collected at 681 sites. Neutron activation analysis results are given for uranium and 16 other elements in sediments, for

uranium and 8 other elements in ground water, and for uranium and 9 other elements in surface water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps.

34318 **(DPST—81-146-13) Vya 1° x 2° NTMS area, Nevada data report (abbreviated).** Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1981. Contract AC09-76SR00001. 19p. NTIS, PC APC E03/MF A01. Order Number DE81030640.

Includes 7 sheets of 48x and 24x reduction microfiche.

This abbreviated data reort presents results of ground water and stream/surface sediment reconnaissance in the National Topographic Map Series (NTMS) Vya 1° x 2° quadrangle. Surface sediment samples were collected at 1339 sites, at a target sampling density of one site per 13 square kilometers. Surface water samples were collected at 115 of these sites. Ground water samples were collected at 368 sites. Neutron activation analysis (NAA) results are given for uranium and 16 other elements in sediments, and for uranium and 9 other elements in ground water. Mass spectrometry results are given for helium in ground water. Field measurements and observations are reported for each site. Analyticl data and field measurements are presented in tables and maps. Uranium concentrations in the sediments which were above detection limits ranged from 0.50 to 24.3 ppM. The mean of the logarithms of the uranium concentrations was 0.47. Groups of high (>10 ppM) uranium occur in the DC and BF quadrangles.

34319 **(DPST—81-146-14) Baltimore 1° x 2° NTMS area, Maryland, Pennsylvania, Virginia, and West Virginia: data report (abbreviated).** Fay, W.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1981. Contract AC09-76SR00001. 19p. NTIS, PC E02/MF A01. Order Number DE81030639.

Includes 7 sheets of 24x and 48x reduction microfiche.

This abbreviated data report presents results of ground water, surface water, and stream sediment reconnaissance in the National Topographic Map Series (NTMS) Baltimore 1° x 2° NTMS quadrangle. Surface sediment samples were collected at 993 sites. Ground water samples were collected at 777 sites. Neutron activation analysis (NAA) results are given for uranium and 16 other elements in sediments, for uranium and 8 other elements in ground water, and for uranium and 9 other elements in surface water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented. Data from ground water sites include: (1) water chemistry measurements (pH, conductivity, and alkalinity), (2) physical measurements, where applicable (water temperature, well description, etc.), and (3) elemental analyses (U, Al, Br, Cl, Dy, F, Mn, Na, and V). Data from sediment sites include: (1) stream water chemistry measurements (pH, conductivity and alkalinity), and (2) elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation, etc.) are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for most elements and for U/Th and U/Hf ratios are included on the microfiche. Key data from stream water sites include: (1) water quality measurements (pH, conductivity and alkalinity) and (2) elemental analyses (U, Al, Br, Cl, Dy, F, Mg, Mn, Na, and V). Uranium concentrations in the sediments that were above detection limits ranged from up to 38.7 ppM. The samples with high uranium values also have high thorium values, suggesting that most of the uranium is held within resistate minerals. The north-northeast trend of the geologic units is clearly reflected in the data.

34320 **(DPST—81-146-15) Cumberland and Pittsburgh 1° x 2° NTMS areas Maryland, Pennsylvania, Virginia, and West Virginia: data report (abbreviated). National uranium resource evaluation program, hydrogeochemical and stream sediment reconnaissance.** Fay, W.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1981. Contract AC09-76SR00001. 19p. NTIS, PC E03/MF A01. Order Number DE81030642.

Includes 10 sheets of 24x and 48x reduction microfiche.

This report summarizes results of ground water, surface water, and stream sediment reconnaissance in the National Topographic Map Series (NTMS) Cumberland and Pittsburgh 1° x 2° NTMS quadrangles. Surface sediment samples were collected at 1042 sites in the Cumberland quadrangle and 342 sites in the Pittsburgh quadrangle. Ground water samples were collected at 1240 sites in the Cumberland quadrangle and 467 sites in the Pittsburgh quadrangle. Neutron activation analysis results are given for uranium and 16 other elements in sediments, for uranium and 8 other elements in ground water, and for uranium and 9 other elements in surface water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps.

34321 **(GJBX—78-81) Geologic report on the San Rafael Swell Drilling Project, San Rafael Swell, Utah.** Bluhm, C.T.; Rundle, J.G. (Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations). Aug 1981. Contract AC13-76GJ01664. 170p. NTIS PCE 08/MF $6.00. Order Number DE82000317.

Includes 18 sheets of 24x reduction microfiche.

Twenty-two holes totaling 34,874 feet (10,629.6 meters) were rotary and core drilled on the northern and western flanks of the San Rafael Swell to test fluvial-lacustrine sequences of the Morrison Formation and the lower part of the Chinle Formation. The objective of the project was to obtain subsurface data so that improved uranium resource estimates could be determined for the area. Although the Brushy Basin and the Salt Wash Members of the Morrison Formation are not considered favorable in this area for the occurrence of significant uranium deposits, uranium minerals were encountered in several of the holes. Some spotty or very low-grade mineralization was also encountered in the White Star Trunk area. The lower part of the Chinle Formation is considered to be favorable for potentially significant uranium deposits along the west flank of the San Rafael Swell. One hole (SR-202) east of Ferron, Utah, intersected uranium, silver, molybdenum, and copper mineralization. More exploratory drilling in the vicinity of this hole is recommended. As a result of the study of many geochemical analyses and a careful determination of the lithology shown by drilling, a sabkha environment is suggested for the concentration of uranium, zinc, iron, lead, copper, silver, and perhaps other elements in parts of the Moody Canyon Member of the Moenkopi Formation.

34322 **(GJBX—224-81-Vol.2) Design of a borehole data-acquisition/transmission system. Final report, Volume II.** Hancock, R.L.; Bowden, J.C. (Science Applications, Inc., La Jolla, CA (USA)). Jun 1981. Contract AC13-76GJ01664. 112p. (SAI—272-81-147-147-LJ). NTIS, PC A06/MF A01. Order Number DE81023609.

34323 **(GJBX—290-81) Hydrogeochemical and stream sediment reconnaissance basic data for Ruby Quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Jul 1981. Contract W-7405-ENG-26. 104p. (K/UR—354). NTIS, PC E01/MF A01. Order Number DE81029982.

Includes 1 sheet of 48x reduction microfiche.

Field and laboratory data are presented for 693 water samples from the Ruby Quadrangle, Alaska. The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

34324 **(GJBX—296-81) Airborne gamma-ray spectrometer and magnetometer survey, Wainwright Quadrangle, Alaska. Final report.** (Western Geophysical Co. of America, Houston, TX. Aero Service Div.). Mar 1981. Contract AC13-76GJ01664. 132p. NTIS, PC A07/MF A01. Order Number DE82000329.

Includes 6 sheets of 48x reduction microfiche.

The results obtained from a gamma-ray spectrometer and magnetometer survey over the Wainwright map area of Alaska are presented. Based on the criteria outlined in the general section of interpretation, a total of seven uranium anomalies have been outlined on the interpretation map. With the exception of Anomaly 1, all are located over the higher terrain of the foothills in the southern portion of the quadrangle. All seven anomalies are only weakly to moderately anomalous. There are no indications anywhere within the area of any significant preferential accumulations of ura-

nium. None of the anomalies are thought to be of any economic importance. No follow-up work is recommended.

34325 **(GJBX—297-81) Airborne gamma-ray spectrometer and magnetometer survey, Meade River Quadrangle, Alaska. Final report.** (Western Geophysical Co. of America, Houston, TX. Aero Service Div.). Feb 1981. Contract AC13-76GJ01664. 132p. NTIS, PC E06/MF A01. Order Number DE82000328.

Includes 6 sheets of 48x reduction microfiche.

The results obtained from an airborne high sensitivity gamma-ray spectrometer and magnetometer survey over the Meade River map area of Alaska are presented. Based on the criteria outlined in the general section on interpretation, a total of eight uranium anomalies have been outlined on the interpretation map. Most of these are only weakly to moderately anomalous. Zones 3 and 7 are relatively better than the others though none of the anomalies are thought to be of any economic significance. No follow-up work is recommended.

34326 **(GJBX—298-81) Airborne gamma-ray spectrometer and magnetometer survey, Teshekpuk Quadrangle, Alaska. Volume I. Final report.** (Western Geophysical Co. of America, Houston, TX. Aero Service Div.). Mar 1981. Contract AC13-76GJ01664. 82p. NTIS, PC E05/MF A01. Order Number DE82000333.

Includes 6 sheets of 48x reduction microfiche.

The results obtained from an airborne high sensitivity gamma-ray spectrometer and magnetic survey over the Teshekpuk map area of Alaska are presented. Based on the criteria outlined in the general section on interpretation, no anomalies have been mapped in the Teshekpuk Quadrangle.

34327 **(GJBX—299-81) Airborne gamma-ray spectrometer and magnetometer survey: Harrison Bay Quadrangle, Alaska. Final report, Volume 1.** (Western Geophysical Co. of America, Houston, TX. Aero Service Div.). Feb 1981. Contract AC13-76GJ01664. 130p. NTIS, PC E06/MF A01. Order Number DE82000338.

Includes 6 sheets of 48x reduction microfiche.

During the months of July and August of 1980, Aero Service Division Western Geophysical Company of America conducted an airborne high sensitivity gamma-ray spectrometer and magnetometer survey over eleven (11) 3° x 1° and one (1) 4° x 1° NTMS quadrangles of the Alaska North Slope. These include the Barrow, Wainwright, Meade River, Teshekpuk, Harrison Bay, Beechey Point, Point Lay, Utukok River, Lookout Ridge, Ikpikpuk River, Umiat, and Sagavanirktok quadrangles. This report discusses the results obtained over the Harrison Bay map area.

34328 **(GJBX—300-81) Airborne gamma-ray spectrometer and magnetometer survey: Beechey Point Quadrangle, Alaska. Volume 1. Final report.** (Western Geophysical Co. of America, Houston, TX. Aero Service Div.). Feb 1981. Contract AC13-76GJ01664. 115p. NTIS, PC E05/MF A01. Order Number DE82000332.

Includes 2 sheets of 48x reduction microfiche.

The results obtained from an airborne high sensitivity gamma-ray spectrometer and magnetometer survey over the Beechey Pt. map area of Alaska are presented. Based on the criteria outlined in the general section on interpretation, a total of five uranium anomalies have been indicated on the interpretation map. All five zones are only weakly to moderately anomalous with zone 2 being relatively better than the other four zones. None are thought to be of any economic significance: No follow-up work is recommended.

34329 **(GJBX—301-81) Airborne gamma-ray spectrometer and magnetometer survey, Point Lay Quadrangle, Alaska. Volume I. Final report.** (Western Geophysical Co. of America, Houston, TX. Aero Service Div.). Feb 1981. Contract AC13-76GJ01664. 122p. NTIS, PC E05/MF A01. Order Number DE82000331.

Includes 2 sheets of 48x reduction microfiche.

The results obtained from an airborne high sensitivity gamma-ray spectrometer and magnetometer survey over the Point Lay map area of Alaska are presented. Based on the criteria outlined in the general section on interpretation, a total of six uranium anomalies have been indicated on the interpretation map. All six are only weakly to moderately anomalous in either uranium or the uranium ratios. None of these are thought to be of any economic significance. No follow-up work is recommended for the Point Lay Quadrangle.

34330 **(GJBX—302-81) Airborne gamma-ray spectrometer and magnetometer survey, Utukok River Quadrangle, Alaska. Volume I. Final report.** (Western Geophysical Co. of America, Houston, TX. Aero Service Div.). Mar 1981. Contract AC13-76GJ01664. 146p. NTIS, PC E06/MF A01. Order Number DE82000330.

Includes 6 sheets of 48x reduction microfiche.

The results obtained from an airborne high sensitivity gamma-ray spectrometer and magnetometer survey over the Utokok River map area of Alaska are presented. Based on the criteria outlined in the general section on interpretation, a total of six uranium anomalies have been outlined on the interpretation map. All of these areas are only weakly to moderately anomalous in uranium and the uranium ratios. None are thought to be indicative of local enrichment of apparent uranium concentrations up to economically significant levels. No follow-up work is recommended.

34331 **(GJBX—303-81) Airborne gamma-ray spectrometer and magnetometer survey: Lookout Ridge Quadrangle, Alaska. Volume I. Final report.** (Western Geophysical Co. of America, Houston, TX. Aero Service Div.). Feb 1981. Contract AC13-76GJ01664. 142p. NTIS PC E06/MF A01. Order Number DE82000327.

Includes 6 sheets of 48x reduction microfiche.

During the months of July and August of 1980, Aero Service Division, Western Geophysical Company of America conducted an airborne high sensitivity gamma-ray spectrometer and magnetometer survey over eleven (11) 3° x 1° and one (1) 4° x 1° NTMS Quadrangles of the Alaska North Slope. These include the Barrow, Wainwright, Meade River, Teshekpuk, Harrison Bay, Beechey Point, Point Lay, Utukok River, Lookout Ridge, Ikpikpuk River, Umiat, and Sagavanirktok Quadrangles. This report discusses the results obtained over the Lookout Ridge map area. The final data are presented in four different forms: on magnetic tape; on microfiche; in graphic form as profiles and histograms; and in map form as anomaly maps, flight path maps, and computer printer maps.

34332 **(GJBX—304-81) Airborne gamma-ray spectrometer and magnetometer survey, Ikpikpuk River Quadrangle Alaska. Volume I. Final report.** (Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations; Western Geophysical Co. of America, Houston, TX. Aero Service Div.). Feb 1981. Contract AC13-76GJ01664. 101p. NTIS, PCE 05/MF A01.

Includes 6 sheets of 48x reduction microfiche.

During the months of July and August of 1980, Aero Service Division Western Geophysical Company of America conducted an airborne high sensitivity gamma-ray spectrometer and magnetometer survey over eleven (11) 3° x 1° and one (1) 4° x 1° NTMS quadrangles of the Alaska North Slope. These include the Barrow, Wainwright, Meade River, Teshekpuk, Harrison Bay, Beechey Point, Point Lay, Utukok River, Lookout Ridge, Ikpikpuk River, Umiat, and Sagavanirktok quadrangles. This report discusses the results obtained over the Ikpikpuk River map area. The final data are presented in four different forms: on magnetic tape; on microfiche; in graphic form as profiles and histograms; and in map form as anomaly maps, flight path maps, and computer printer maps.

34333 **(GJBX—306-81) Airborne gamma-ray spectrometer and magnetometer survey, Sagavanirktok Quadrangle, Alaska. Volume I. Final report.** (Western Geophysical Co. of America, Houston, TX. Aero Service Div.). Mar 1981. Contract AC13-76GJ01664. 102p. NTIS, PC E08/MF A01. Order Number DE82000335.

Incluses 6 sheets of 48x reduction microfiche.

The results obtained from an airborne high sensitivity gamma-ray spectrometer and magnetometer survey over the Sagavanirktok map area of Alaska are presented. Based on the criteria outlined in the general section on interpretation, a total of eight

uranium anomalies have been outlined on the interpretation map. However, all of these zones are only weakly to moderately anomalous. None are thought to be indicative of local enrichment of uranium to economically significant levels. No follow-up work is recommended.

34334 **(GJBX—308-81) Hydrogeochemical and stream sediment reconnaissance basic data for Rawlings quadrangle, Wyoming.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 30 Jun 1981. Contract W-7405-ENG-26. 187p. (K/UR—344). NTIS, PC E07/MF A01. Order Number DE82000249.

Includes 1 sheet of 48x reduction microfiche.

Field and laboratory data are presented for 454 water samples and 1279 sediment samples from the Rawlins Quadrangle, Wyoming. Uranium values have been reported by Los Alamos National Laboratory in Report GJBX-81(78). The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

34335 **(GJBX—310-81) Hydrogeochemical and stream sediment reconnaissance basic data for Iditarod Quadrangle, Alaska.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Jul 1981. Contract W-7405-ENG-26. 157p. (K/UR—375). NTIS, PC E06/MF A01. Order Number DE82000248.

Includes 1 sheet of 48x reduction microfiche.

Field and laboratory data are presented for 1410 water samples from the Iditarod Quadrangle, Alaska. The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

34336 **(GJBX—313-81) Williamsport 1° x 2° NTMS area, Pennsylvania: supplemental data report.** Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1981. Contract AC09-76SR00001. 18p. (DPST—79-146-8S). NTIS, PC E03/MF A01. Order Number DE82000627.

Includes 3 sheets of 24x reduction microfiche.

This data report presents supplemental analytical results for 1328 stream sediment samples that were collected as part of the SRL-NURE reconnaissance in the National Topographic Map Series (NTMS) Williamsport 1° x 2° quadrangle. Results are reported for 23 elements (extractable U, Ag, As, Ba, Be, Ca, Co, Cr, Cu, K, Li, Mg, Mo, Nb, Ni, P, Pb, Se, Sn, Sr, W, Y, and Zn). Analyses are tabulated and displayed graphically on microfiche. Field data and neutron activation analysis (NAA) were open-filed in DPST-79-146-8 [GJBX-152(79)].

34337 **(GJBX—314-81) Santa Cruz 1° x 2° NTMS area, California: data report (abbreviated).** Cook, J.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1981. Contract AC09-76SR00001. 20p. (DPST—81-146-16). NTIS, PC E02/MF $3.70. Order Number DE82000628.

Includes 7 sheets of 24x reduction microfiche.

This abbreviated data report presents results of ground water and stream/surface sediment reconnaissance in the National Topographic Map Series (NTMS) Santa Cruz 1° x 2° quadrangle. Surface sediment samples were collected at 1270 sites, at a target sampling density of one site per 13 square kilometers (five square miles). Ground water samples were collected at 636 sites. Neutron activation analysis (NAA) results are given for uranium and 16 other elements in sediments, and for uranium and 9 other elements in ground water. Mass spectrometry results are given for helium in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Uranium concentrations in the sediments which were above detection limits ranged from 0.10 to 51.2 ppM. The mean of the logarithms of the uranium concentrations was 0.53. A group of high uranium concentrations occurs near the junctions of quadrangles AB, AC, BB, and BC. A line of high uranium concentrations in the San Joaquin Valley is most likely precipitated uranium, either from the weathering of rocks in the area or from fertilizer.

34338 **(GJBX—315-81) Phoenix 1° x 2° NTMS area, California and Arizona: data report (abbreviated).** Bennett, C.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1981. Contract AC09-76SR00001. 19p. (DPST—81-146-18). NTIS, PC E04/MF $3.70. Order Number DE82000629.

Includes 7 sheets of 24x reduction factor.

This abbreviated data report presents results of ground water and stream/surface sediment reconnaissance in the National Topographic Map Series (NTMS) Phoenix 1° x 2° quadrangle. Surface sediment samples were collected at 1388 sites, at a target sampling density of one site per 15 square kilometers (6 square miles). Ground water samples were collected at 155 sites. Neutron activation analysis (NAA) results are given for uranium and 16 other elements in sediments, and for uranium and 9 other elements in ground water. Mass spectrometry results are given for helium in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Uranium concentrations in the sediments which were above detection limits ranged from 1.4 to 132.1 ppM with a mean of 3.5 ppM. Uranium concentrations above detection limits in the ground water samples ranged from 0.240 to 292.6 ppB, with a mean of 10.053 ppB.

34339 **(GJBX—316-81) Phenix City 1° x 2° NTMS area, Alabama and Georgia: data report (abbreviated).** Bennett, C.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1981. Contract AC09-76SR00001. 19p. (DPST—81-146-19). NTIS, PC E03/MF $3.90. Order Number DE82000630.

Includes 8 sheets of 24x reduction microfiche.

This abbreviated data report presents results of ground water, surface water, and stream sediment reconnaissance in the National Topographic Map Series (NTMS) Phenix City 1° x 2° quadrangle. Surface sediment samples were collected at 1153 sites. Ground water samples were collected at 949 sites. Neutron activation analysis (NAA) results are given for uranium and 16 other elements in sediments, for uranium and 8 other elements in ground water, and for uranium and 9 other elements in surface water. Field measurements and observations are reported for each site. Analytical data and field measurments are presented in tables and maps. Uranium concentrations above detection limits in the sediment samples ranged from 1.0 to 171, with a mean of 10.6 ppM. Uranium concentrations detected in the ground water samples ranged from 0.006 to 23.1 ppB, with a mean of 0.28 ppB.

34340 **(GJBX—317-81) San Bernardino 1° x 2° NTMS area, California: data report (abbreviated).** Bennett, C.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1981. Contract AC09-76SR00001. 20p. (DPST—81-146-20). NTIS, PC E03/MF $3.90. Order Number DE82000631.

Includes 8 sheets of 24x reduction microfiche.

This abbreviated data report presents results of ground wate and stream/surface sediment reconnaissance in the National Topographic Map Series (NTMS) San Bernardino 1° x 2° quadrangle. Surface sediment samples were collected at 1539 sites, at a target sampling density of one site per 13 square kilometers (five square miles). Surface water samples were collected at 39 of these sites. Ground water samples were collected at 392 sites. Neutron activation analysis (NAA) results are given for uranium and 16 other elements in sediments, and for uranium and 9 other elements in ground water. Mass spectrometry results are given for helium in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Key data from stream water sites (also on microfiche in pocket) include (1) water quality measurements (pH, conductivity, and alkalinity) and (2) elemental analyses (U, Al, Br, Cl, Dy, F, Mg, Mn, Na, and V). Uranium concentrations above detection limits in the sediment ranged from 1.0 to 137 ppM, with a mean of 4.2 ppM. Uranium concentrations above detection limits in the ground water samples ranged from 0.03 to 93.9 ppB, with a mean of 7.6 ppB.

**34341 (GJBX—327-81) NURE aerial gamma-ray and magnetic reconnaissance survey of Maine and portions of New York. Volume I. Data acquisition, reduction and interpretation. Final report.** (Carson Helicopters, Inc., Perkasie, PA (USA)). Aug 1981. Contract AC13-76GJ01664. 273p. NTIS, PC A12/MF A01. Order Number DE82000650.

As part of the Department of Energy (DOE) National Uranium Resource Evaluation Program, Carson Geoscience Company has performed a rotary-wing high sensitivity radiometric and magnetic survey of the State of Maine and of the Binghamton, Ogdensubrg and Utica 1:250,000 scale quadrangles in New York State. The area surveyed consisted of approximately 14,424 line miles. The survey was flown with a Sikorsky S58T helicopter equipped with a high sensitivity gamma ray spectrometer which was calibrated at the DOE calibration facilities at Walker field in Grand Junction, Colorado, and the Dynamic Test Range at Lake Mead, Arizona. The radiometric data was processed to compensate for Compton scattering effects and altitude variations. The data was normalized to 400 feet terrain clearance. The reduced data is presented in the form of stacked profiles, standard deviation anomaly plots, histogram plots and microfiche listings. The profiles, anomaly maps and histograms are presented in the individual quadrangle reports. The results of the geologic interpretation of the radiometric data for each quadrangle is presented as individual chapters of this narrative report.

**34342 (GJBX—327-81-Vol.2-BANGOR) NURE aerial gamma-ray and magnetic reconnaissance survey of Maine and portions of New York. Final report.** (Carson Helicopters, Inc., Perkasie, PA (USA)). Jul 1981. Contract AC13-76GJ01664. 260p. NTIS, E10/MF $5.10. Order Number DE82000794.

Includes 13 sheets of 48x reduction microfiche.

Volume II contains the flight line base maps, anomaly maps (uranium, thorium, potassium, uranium/thorium, uranium/potassium, thorium/potassium), total count maps, magnetic field maps, uranium maps, thorium maps, potassium maps, ratio maps for U/T, U/K, T/K, radiometric multiple-parameter stacked profiles, magnetic and ancillary stacked profile data, and histograms.

**34343 (GJBX—327-81-Vol.2-BINGHAMTON) NURE aerial gamma-ray and magnetic reconnaissance survey of Maine and portions of New York. Final report.** (Carson Helicopters, Inc., Perkasie, PA (USA)). Jul 1981. Contract AC13-76GJ01664. 150p. NTIS, E06/MF $4.90. Order Number DE82000869.

Includes 8 sheets of 48x reduction microfiche.

Volume II contains the flight line base map, anomaly maps (uranium, thorium, potassium, uranium/thorium, uranium/potassium, thorium/potassium), total count map, magnetic field map, uranium map, thorium map, potassium map, ratio maps for U/T, U/K, T/K, radiometric multiple-parameter stacked profiles, magnetic and ancillary stacked profile data, and histograms.

**34344 (GJBX—327-81-Vol.2-EDMUNDSTON) NURE aerial gamma-ray and magnetic reconnaissance survey of Maine and portions of New York. Final report.** (Carson Helicopters, Inc., Perkasie, PA (USA)). Jun 1981. Contract AC13-76GJ01664. 242p. NTIS, E11/MF $4.90. Order Number DE82000785.

Includes 11 sheets of 48x reduction microfiche.

Volume II contains the flight line base maps, anomaly maps (urnaium, thorium, potassium, uranium/thorium, uranium/potassium, thorium/potassium), radiometric multiple-parameter stacked profiles, magnetic and ancillary stacked profile data, histograms, total count maps, magnetic field maps, uranium maps, thorium maps, potassium maps, ratio maps for U/T, U/K, and T/K.

**34345 (GJBX—327-81-Vol.2-FREDERICTON) NURE aerial gamma-ray and magnetic reconnaissance survey of Maine and portions of New York. Final report.** (Carson Helicopters, Inc., Perkasie, PA (USA)). Jun 1981. Contract AC13-76GJ01664. 306p. NTIS, E11/MF $4.10. Order Number DE82000772.

Includes 7 sheets of 48x reduction microfiche.

Volume II contains the flight path maps, anomaly maps (uranium, thorium, potassium, uranium/thorium, uranium/potassium, thorium/potassium), radiometric multiple-parameter stacked profiles, magnetic and ancillary stacked profile data, histograms, total count maps, magnetic field maps, uranium maps, thorium maps, potassium maps, ratio maps for U/T, U/K, and T/K.

**34346 (GJBX—327-81-Vol.2-LEWISTON) NURE aerial gamma-ray and magnetic reconnaissance survey of Maine and portions of New York. Final report.** (Carson Helicopters, Inc., Perkasie, PA (USA)). Jul 1981. Contract AC13-76GJ01664. 80p. NTIS, E05/MF$3.70. Order Number DE82000872.

Includes 7 sheets of 48x reduction microfiche.

Volume II contains the flight line base map, anomaly maps (uranium, thorium, potassium, uranium/thorium, uranium/potassium, thorium/potassium), total count map, magnetic field map, uranium map, thorium map, potassium map, ratio maps for U/T, U/K, T/K, radiometric multiple-parameter stacked profiles, magnetic and ancillary stacked profile data, and histograms.

**34347 (GJBX—327-81-Vol.2-MILLINOCKET) NURE aerial gamma-ray and magnetic reconnaissance survey of Maine and portions of New York. Final report.** (Carson Helicopters, Inc., Perkasie, PA (USA)). Jun 1981. Contract AC13-76GJ01664. 168p. NTIS, E07/MF $4.90. Order Number DE82000780.

Includes 8 sheets of 48x reduction microfiche.

Volume II contains the flight line base map, anomaly maps (uranium, thorium, potassium, uranium/thorium, uranium/potassium, thorium/potassium), total count map, potassium map, ratio maps for uranium/thorium, uranium/potassium, thorium/potassium, radiometric multiple-parameter stacked profiles, magnetic and ancillary stacked profile data, and histograms.

**34348 (GJBX—327-81-Vol.2-OGDENSBURG) NURE aerial gamma-ray and magnetic reconnaissance survey of Maine and portions of New York. Final report.** (Carson Helicopters, Inc., Perkasie, PA (USA)). Jul 1981. Contract AC13-76GJ01664. 140p. NTIS, PC E06/MF A01. Order Number DE82000401.

Includes 6 sheets of 48x reduction microfiche.

Volume II contains the flight line base map anomaly maps (uranium, thorium, potassium, uranium/thorium, uranium/potassium, thorium/potassium), total count map, magnetic field map, uranium map, thorium map, potassium map, ratio maps for uranium/thorium, uranium/potassium, thorium/potassium, radiometric multiple-parameter stacked profiles, magnetic and ancillary stacked profile data, and histograms.

**34349 (GJBX—327-81-Vol.2-SHERBROOKE) NURE aerial gamma-ray and magnetic reconnaissance survey of Maine and portions of New York. Final report.** (Carson Helicopters, Inc., Perkasie, PA (USA)). Jul 1981. Contract AC13-76GJ01664. 124p. NTIS, E05/MF A01. Order Number DE82000781.

Includes 4 sheets of 48x reduction microfiche.

Volume II contains the flight line base map, anomaly maps (uranium, thorium, potassium, uranium/thorium, uranium/potassium, thorium/potassium), total count map, magnetic field map, uranium map, thorium map, potassium map, ratio maps for uranium/thorium, uranium/potassium, thorium/potassium, radiometric multiple-parameter stacked profiles, magnetic and ancillary stacked profile data, and histograms.

**34350 (GJBX—327-81-Vol.2-UTICA) NURE aerial gamma-ray and magnetic reconnaissance survey of Maine and portions of New York. Final report.** (Carson Helicopters, Inc., Perkasie, PA (USA)). Jul 1981. Contract AC13-76GJ01664. 166p. NTIS, E07/MF $4.90. Order Number DE82000784.

Includes 8 sheets of 48x reduction microfiche.

Volume II contains the flight line base map, anomaly maps (uranium, thorium, potassium, uranium/thorium, uranium/potassium, thorium/potassium), radiometric multiple-parameter stacked profiles, magnetic and ancillary stacked profile data, histograms, total count map, magnetic field map, uranium map, thorium map, potassium map, ratio maps for U/T, U/K, and T/K.

34351 **Method of assaying uranium with prompt fission and thermal neutron borehole logging adjusted by borehole physical characteristics.** Barnard, R.W.; Jensen, D.H. (to Dept. of Energy). US Patent Application 204,721. 5 Nov 1980. 22p.

Uranium formations are assayed by prompt fission neutron logging techniques. The uranium in the formation is proportional to the ratio of epithermal counts to thermal or epithermal dieaway. Various calibration factors enhance the accuracy of the measurement.

## 0505 Enrichment

*REFER ALSO TO CITATION(S) 35312, 35314*

34352 **(K/ET—5023) 16 μm $CO_2$ bending mode laser system.** Kasner, W.H.; Toth, V.A.; Akerman, M.A. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.; Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 2 Jun 1981. Contract W-7405-ENG-26. 19p. (CONF-810613—11). NTIS, PC A02/MF A01. Order Number DE81030123.

From Conference on lasers and electro-optics; Washington, DC, USA (10 Jun 1981).

A 16 μm $CO_2$ bending mode laser system yielding output energies of 40 to 50 mJ/pulse is described. This system uses resistor ballasted pin-pin electrodes and transverse pulsed electrical discharge excitation of cold $CO_2$:$N_2$:He gas mixtures.

## 0507 Fuels Production And Properties

*REFER ALSO TO CITATION(S) 34791, 34917, 35213, 35313, 35315*

34353 **Particle blender.** Willey, M.G. (to Dept. of Energy). US Patent 4,272,232. 9 Jun 1981. Filed date 7 Aug 1979. vp.

An infinite blender that achieves a homogeneous mixture of fuel microspheres is provided. Blending is accomplished by directing respective groups of desired particles onto the apex of a stationary coaxial cone. The particles progress downward over the cone surface and deposit in a space at the base of the cone that is described by a flexible band provided with a wide portion traversing and in continuous contact with the circumference of the cone base and extending upwardly therefrom. The band, being attached to the cone at a narrow inner end thereof, causes the cone to rotate on its arbor when the band is subsequently pulled onto a take-up spool. As a point at the end of the wide portion of the band passes the point where it is tangent to the cone, the blended particles are released into a delivery tube leading directly into a mold, and a plate mounted on the lower portion of the cone and positioned between the end of the wide portion of the band and the cone assures release of the particles only at the tangent point.

## 0508 Spent Fuels Reprocessing

*REFER ALSO TO CITATION(S) 35276, 35334*

34354 **(AGNS—35900-CONF-130) First-cycle studies of coprocessing flowsheets.** Gray, J.H. (Allied-General Nuclear Services, Barnwell, SC (USA)). Jun 1981. Contract AC09-78ET35900. 7p. (CONF-811103—12). NTIS, PC A02/MF A01. Order Number DE81028761.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

Selected portions of two coprocessing flowsheets developed for use at the Barnwell Nuclear Fuel Plant (BNFP) have been tested in the laboratory with uranium, plutonium, and fission products. Processing conditions and stream compositions for first cycle extraction and uranium-plutonium partitioning in an electropulse column were controlled to examine the behavior of nitric acid, uranium, plutonium, and fission products during coprocessing. The ability to adapt coprocessing technology for use in the BNFP reprocessing facility was successful for first cycle extraction and partition. The only process adjustment involved a reduction in nitric acid concentration to attain proper uranium to plutonium ratios.

34355 **(CONF-800943—20) Development of reprocessing technology for breeder recycle.** Groenier, W.S.; Crouse, D.J.; Vondra, B.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 19p. NTIS, PC A02/MF A01. Order Number DE81032035.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

This paper is an overview of some of the activities under the Consolidated Fuel Reprocessing Program. Current status of technology for portions of four reprocessing development tasks is summarized: voloxidation, dissolution, solvent extraction, and off-gas processing. The Hot Experimental Facility is alos mentioned. 6 figures. (DLC)

34356 **(ORNL/TM—7914) Consolidated fuel reprocessing program. Progress report, April 1-June 30, 1981.** Burch, W.D.; Feldman, M.J.; Groenier, W.S.; Yarbro, O.O.; Unger, W.E. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 47p. NTIS, PC A03/MF A01. Order Number DE82000506.

Activities and progress are summarized in the following areas: process development, laboratory R and D, engineering research (voloxidation, dissolution, feed preparation, solvent extraction, off-gas processing), engineering systems, integrated equipment test (IET) facility operations, and HTGR fuel reprocessing. (DLC)

34357 **Method for cleaning solution used in nuclear fuel reprocessing.** Tallent, O.K.; Crouse, D.J.; Mailen, J.C. (to Dept. of Energy). US Patent Application 217,357. 17 Dec 1980. 9p.

Nuclear fuel processing solution consisting of tri-n-butyl phosphate and dodecane, with a complex of uranium, plutonium, or zirconium and with a solvent degradation product such as di-n-butyl phosphate therein, is contacted with an aqueous solution of a salt formed from hydrazine and either a dicarboxylic acid or a hydroxycarboxylic acid, thereby removing the aforesaid complex from the processing solution.

34358 **Method for separating actinides.** Friedman, H.A.; Toth, L.M. (to Dept. of Energy). US Patent Application 205,075. 10 Nov 1980. 8p.

An organic solution used for processing spent nuclear reactor fuels is contacted with an aqueous nitric acid solution to strip Np(VI), U(VI), and Pu(IV) from the organic solution into the acid solution. The acid solution is exposed to ultraviolet light, which reduces Np(VI) to Np(V) without reducing U(VI) and Pu(IV). Since the solubility of Np(V) in the organic solution is much lower than that of Np(VI), U(VI), and Pu(IV), a major part of the Np is stripped from the organic solution while leaving most of the U and Pu therein.

## 0509 Transport And Storage

*REFER ALSO TO CITATION(S) 34390, 35322, 35323, 35324*

34359 **(DP—1582) Licensing schedule for away-from-reactor (AFR) spent fuel storage facilities.** Gray, P.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1981. Contract AC09-76SR00001. 26p. NTIS, PC A03/MF A01. Order Number DE82000408.

The Nuclear Regulatory Commission has authority to issue licenses for Away-From-Reactor (AFR) installations for the storage of spent nuclear fuel. This report presents a detailed estimate of the time required to prosecute a licensing action. The projected licensing schedule shows that the elapsed time between filing an application and issuance of a license will be about 32 months, assuming intervention. The legal procedural steps will determine the time schedule and will override considerations of technical complexity. A license could be issued in about 14 months in the absence of intervention.

34360 **(DP-MS—81-40) Spent LWR fuel-storage costs.** Clark, H.J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1981. Contract AC09-76SR00001. 32p. (CONF-811108—2). NTIS, PC A03/MF A01. Order Number DE81027498.

From Annual meeting of the Institute of Chemical Engineers; New Orleans, LA, USA (8 Nov 1981).

Expanded use of existing storage basins is clearly the most economic solution to the spent fuel storage problem. The use of high-density racks followed by fuel disassembly and rod storage is an order of magnitude cheaper than building new facilities adjacent to the reactor. The choice of a new storage facility is not as obvious; however, if the timing of expenditures and risk allowance are to be considered, then modular concepts such as silos, drywells, and storage casks may cost less than water basins and air-cooled vaults. A comparison of the costs of the various storage techniques without allowances for timing or risk is shown. The impact of allowances for discounting and early resumption of reprocessing is also shown. Economics is not the only issue to be considered in selecting a storage facility. The licensing, environmental impact, timing, and social responses must also be considered. Each utility must assess all of these issues for their particular reactors before the best storage solution can be selected.

34361 **(HEDL-TC—1601-Rev.1) STAFF-5, a two-dimensonal computer model for simulation of the performance of spent fuel in storage/disposal.** Fields, S.R.; Fletcher, J.F. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1981. Contract AC14-76FF02170. 123p. NTIS, PC A06/MF A01. Order Number DE82000043.

STAFF-5, (Spent Fuel Temperature and Cladding Failure Forecaster), a two-dimensional model of a light-water reactor (LWR) fuel assembly in a canister, has been developed to predict spent fuel temperature and study cladding performance during long-term storage and/or disposal. When symmetry of the storage configuration is considered, STAFF-5 provides three-dimensional simulation of the fuel assembly and canister. The heat transfer portion of STAFF was validated against experimental results from instrumented tests of fuel assemblies in selected disposal configurations.

34362 **(PNL—3868) Spent fuel and fuel pool component integrity. Annual report, FY 1980.** Johnson, A.B. Jr.; Bailey, W.J.; Bradley, E.R.; Bruemmer, S.M.; Langstaff, D.C. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1981. Contract AC06-76RL01830. 38p. NTIS, PC A03/MF A01. Order Number DE82000712.

During program FY 1980 staff members of the Spent Fuel and Fuel Pool Component Integrity Program at Pacific Northwest Laboratory (PNL) completed the following major tasks: represented DOE on the international Behavior of Fuel Assemblies in Storage (BEFAST) Committee; the program manager, A.B. Johnson, Jr., participated in an International Survey of Water Reactor Spent Fuel Storage Experience, which was conducted jointly by the International Atomic Energy Agency (Vienna) and the Nuclear Energy Agency (Paris); provided written testimony and cross statement for the Proposed Rulemaking on Storage and Disposal of Nuclear Waste; acquired and began examination of the world's oldest pool-stored Zircaloy-clad fuel from the Shippingport reactor, stored ~ 21 years in deionized water; acquired and began examination of stainless-clad spent fuel from the Connecticut Yankee Reactor (PWR); negotiated for specimens from components stored in spent fuel pools at fuel storage facilities from the Savannah River Plant, Aiken, South Carolina, Zion (PWR) spent fuel pool, Zion, Illinois, and La Crosse (BWR) spent fuel pool, La Crosse, Wisconsin; planned for examinations in FY 81 of specimens from the three spent fuel pools; investigated a low-temperature stress corrosion cracking mechanism that developed in piping at a few PWR spent fuel pools. This report summarizes the results of these activities and investigations. Details are provided in the presentationsand publications generated under this program and summarized in Appendix A.

34363 **(PNL—3945) Thermohydraulic analysis of BWR and PWR spent fuel assemblies contained within square canisters.** Wiles, L.E.; McCann, R.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1981. Contract AC06-76RL01830. 100p. NTIS, PC A05/MF A01. Order Number DE82000413.

This report presents the results of several thermohydraulic simulations of spent fuel assembly/canister configurations performed in support of a program investigating the feasibility of storing spent nuclear fuel assemblies in canisters that would be stored in an air environment. Eleven thermohydraulic simulations were performed. Five simulations were performed using a single BWR fuel assembly/canister design. The various cases were defined by changing the canister spacing and the heat generation rate of the fuel assembly. For each simulation a steady-state thermohydraulic solution was achieved for the region inside the canister. Similarly, six simulations were performed for a single PWR fuel assembly/canister design. The square fuel rod arrays were contained in square canisters which would permit closer packing of the canisters in a storage facility. However, closer packing of the canisters would result in higher fuel temperatures which would possibly have an adverse impact on fuel integrity. Thus, the most important aspect of the analysis was to define the peak fuel assembly temperatures for each case. These results are presented along with various temperature profiles, heat flux distributions, and air velocity profiles within the canister. 48 figures, 4 tables.

34364 **(SAND—81-1188C) Experimental source term data base for assessing the safety of spent fuel transportation.** Sandoval, R.P.; Vigil, M.G.; Newton, G.J. (Sandia National Labs., Albuquerque, NM (USA); Inhalation Toxicology Research Inst., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 5p. (CONF-811103—5). NTIS, PC A02/MF A01. Order Number DE81023692.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

This paper deals with a program currently underway at Sandia National Laboratories (SNL) to characterize source term aerosols produced from exposing spent fuel transport systems to extraordinary environments and to produce improved estimates of environmental and health consequences. The extreme environments of interest have been divided into two categories: those related to explosive attack and those related to extra-severe accidents. Efforts in this program to date have concentrated on the development of an experimental data base characterizing the release of radioactive material (i.e. source terms) resulting from explosive attacks on spent fuel casks. This experimental data base is the primary input to an analysis of the human health and economic consequences.

34365 **(SAND—81-1509) Operational and regulatory impacts of regional management on transportation of commercial low-level radioactive waste.** Shirley, C.G.; Wilmot, E.L.; Shepherd, E.W. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1981. Contract AC04-76DP00789. 36p. (TTC—0228). NTIS, PC A03/MF A01. Order Number DE82000967.

The 96th Congress of the United States, as part of the Low-level Radioactive Waste Policy Act of 1980 (Public Law 96-573), instructed the Secretary of the Department of Energy (DOE) to prepare a report on the current US low-level waste management situation and the conditions and requirements for management on a regional basis. The Transportation Technology Center has compared the transportation requirement and regional management scenarios for commercial low-level radioactive waste in support of the DOE response to this instruction. Using 1979 low-level waste volumes shipped to commercial burial grounds and six management regions postulated by DOE, transportation requirements were estimated and compared for the two management scenarios in terms of cumulative shipping distance and transportation cost. Effects of these results on the demand for transportation services and equipment and on population risks were considered. Finally, current regulatory issues and the potential effects of regional management on regulation of low-level waste transportation were reviewed.

34366 **(SAND—81-1509C) Operational and regulatory impacts of regional management on transportation of commercial low-level radioactive waste.** Shirley, C.G.; Wilmot, E.L.; Shepherd, E.W. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 4p. (CONF-811103—3). NTIS, PC A02/MF A01. Order Number DE81025399.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

Results of the analysis indicate that a factor of two reduction in total shipping distance and cost is possible on a national scale if

regional disposal sites are employed. Likewise, population risks and the demand for transportation services and equipment would be proportionally reduced because of shorter shipment distances and trip durations. The fate of regionalization of low level waste management and achievement of the cost and risk benefits that it implies is dependent on solving technical problems and resolving the institutional issues which result in multiple levels of regulations.

**34367 (SAND—81-1523C) Sensitivity analysis of transportation parameters on spent-fuel-cask projections.** McGuire, S.C.; Joy, D.S.; Cashwell, J.W. (Sandia National Labs., Albuquerque, NM (USA); Oak Ridge National Lab., TN (USA)). 1981. Contract AC04-76DP00789. 12p. (CONF-811103—9; TTC—0229). NTIS, PC A02/MF A01. Order Number DE81025833.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

The parameters varied were average carrier speed, turnaround time at either end of shipping route, and cask availability. For a storage facility in the northwest US, the cask fleet requirements are most sensitive to the average transportation speed. The greatest effect on cask requirements for the midwestern facility results from variations in cask turnaround times. (DLC)

**34368 (SAND—81-1560C) Demand forecast for rail shipment of radioactive material in the United States.** Allen, G.C.; Cashwell, J.W. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 10p. (CONF-811103—8; TTC—0232). NTIS, PC A02/MF A01. Order Number DE81025859.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

A summary of the market potential for radioactive material (in millions of ton-miles) is presented in tabular form. These include the following: milled uranium ore; mill tailings; natural uranium hexafluoride; enriched uranium hexafluoride; fresh fuel, spent fuel; low-level waste; transuranic waste; and high-level waste. The maximum realistic market share for rail carriers is always less than these values because of the lack of rail access to some shipping and receiving facilities, small material quantities which could most easily move by other modes, short shipping distances for certain transport segments and greater operational convenience of other modes for some material categories. While market share and revenues for radioactive material are presently small, rail carriers appear to have a market advantage for milled uranium ore, transuranic waste and high-level waste. The potential for a significantly increased market share exists for spent fuel and uranium hexafluoride. While more fresh fuel and low-level waste can be transported by rail, it is unlikely that rail market share for radioactive materials (RAM) in general will rise to the potential maximum because many of these materials have historically been moved by truck and transported in frequent, small shipments.

**34369 (UCRL—86100) Tape extensometer sensitivity and reliability.** Yow, J.L. Jr.; Wilder, D.G. (Lawrence Livermore National Lab., CA (USA)). 21 Sep 1981. Contract W-7405-ENG-48. 33p. (CONF-810972—1). NTIS, PC A03/MF A01. Order Number DE82000064.

From 24. annual meeting of the Association of Engineering Geologists; Portland, OR, USA (27 Sep 1981).

The Spent Fuel Test-Climax is a test of retrievable storage in granite of spent nuclear reactor fuel. The rock has been instrumented to measure temperatures, stress changes, and displacements. Periodic tape extensometer readings provide test drift convergence data. Vertical and horizontal tape readings are made at five locations in each of two 3.4m x 3.4m (11 ft x 11 ft) drifts and six locations in a 4.6m x 6.2m (15 ft x 20.5 ft) drift. The sensitivity of the readings to temperature effects, errors in temperature corrections, change of steel tape, and change of operator has been examined. Calculated corrections for temperature-induced changes in distance range from 0.001 in. to 0.003 in./°C. A tape changeout evidenced both a systematic error apparently due to slight changes in tape registration during punching and to nonidentical location of punched holes in the two tapes and a random error due to variability of reading and punching operations. These errors were corrected by making duplicate measurements for the tapes. Tape readings by the same operator have been repeatable within +-0.001 in. in the smaller drifts and +-0.002 in. in the larger. Different operators have been able to repeat readings to within +-0.004 in. (usually within +-0.002 in.) with generally consistent direction of offset between operators. Corrections of readings and review of plotted data show the tape extensometer to be a reliable instrument for tunnel convergence measurements.

## 0510 Marketing And Economics

**34370 (NP—2900091) Uranium resources to meet long-term uranium requirements: summary of EPRI Special Report No. 5.** Searl, M.F. (Electric Power Research Inst., Palo Alto, CA (USA). Energy Systems, Environment and Conservation Div.). Nov 1974. 22p. NTIS, PC A02/MF A01. Order Number DE82900091.

This study seeks to explore the uncertainty concerning two particular aspects of the larger question of economic growth and energy supply, namely the size of the nation's uranium resource and future levels of uranium consumption. For the reader's guidance subjective probability levels are attached to the estimates derived for each of these items. While the analysis here hopefully reduces uncertainty in some areas, the geological and statistical underpinnings of the analysis and the published data on which they are based are not so strong as to support a conclusion that this is the final word in the analysis of uranium resources.

## 0520 Waste Management

*REFER ALSO TO CITATION(S) 34362, 34397, 34398, 34398, 34399, 34400, 34401, 34927, 35210, 35321, 35323, 35400, 35470, 35530*

**34371 (ORNL-tr—4761) [Storage and solidification of MAW/LAW in underground cavities]. 3. Product properties in the operating phase. Final report.** Leers, K.J. (Oak Ridge National Lab., TN (USA)). [nd]. Translation source information not available . 183p. NTIS, PC A09/MF A01. Order Number DE81032038.

A simulated concentrate of medium-activity waste was used to produce a solidified product which would exhibit good, long-term stability and minimal leaching rates. The assessment included measurements of strengths, elastic moduli, porosity, mineral analysis, and leaching resistance. Among the types of cements used were: PZ 35 F and 55 F, furnace slag, iron Portland, deep-well, etc. Additives used to decrease leaching included ashes, sandstone, silica, etc. Best stability without additives was produced by Portland cement. Best additives were cement sealing agents based on vinyl propionate/vinyl chloride polymer, sodium silicate hydrate, and bentonite. Solids produced using blast-furnace slag cement were unstable. 155 figures, 20 tables. (DLC)

**34372 (DOE/ET/46633—T1) Borehole Plugging Program (waste disposal). Report 2. Petrographic examination of several four-year-old laboratory developed grout mixtures.** Rhoderick, J.E.; Buck, A.D. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Structures Lab.). Sep 1981. Contract AI97-81ET46633; AC04-76DP00789. 22p. NTIS, PC A02/MF A01. Order Number DE82000066.

Specimens from five grout mixtures had been stored in either simulated brine groundwater at 73°F or in laboratory air for approximately 4 years. The variables included type of cement, use of a natural pozzolan, and use of salt in two mixtures. Available specimens were inspected; a specimen stored wet and one stored dry from each grout mixture were examined by x-ray diffraction for phase composition and by scanning electron microscopy to study microstructure. The results showed that: cracking of specimens was common; it was believed to be due mainly to temperature change and/or moisture change effects; the mixture variables were generally not recognizable; and the phase composition and microstructure of the five grout mixtures were considered normal.

**34373 (DOE/ET/46633—T2) Examination of ERDA-10 grout specimens at different ages.** Buck, A.D.; Burkes, J.P.; Rhoderick, J.E. (Sandia National Labs., Albuquerque, NM (USA); Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Structures Lab.; Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Aug 1981. Contract AC04-76DP00789;AI97-81ET46633. 40p. NTIS, PC A03/MF A01. Order Number DE82000095.

A borehole in Eddy Co., N. Mex. designated ERDA-10 was filled with portland cement base grout in October 1977. The hole was filled with grout of four compositions, three of which were similar and made with salt water as mixing water; the upper portion of the hole was filled with a grout made using fresh water as mixing water. Tests and examinations were made after 23 +- 8 days, 1 year, and 3 years. This report presents results of petrographic examination. The grouts made with salt water formed tetracalcium aluminate dichloride-10-hydrate ($C_3A(CaCl_2)H_{10}$) at the expense of ettringite during continued hydration. The $C_3A(CaCl_2)H_{10}$ was already present when the grouts were examined at the early ages (23 +- 8 days). The amount of calcium hydroxide in both the saltwater and the freshwater grouts decreased with age. The microstructures of the grouts showed progressive densification with age. This microstructure was always fairly open due to the high water-to-solids ratios; these were 0.64 to 0.74 by mass for the three saltwater grouts and 0.49 for the freshwater grouts. Phase composition and microstructure were considered normal for these materials. It was found that carbonation had taken place during 3 years of immersion in salt water or fresh water. Carbonation was largely confined to surfaces of specimens. Some cracking of specimens took place.

**34374 (DOE/NE—0017) Spent fuel and radioactive waste inventories and projections as of December 31, 1980.** (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 293p. NTIS, PC A13/MF A01. Order Number DE82000307.

Current inventories and characteristics of commercial spent fuels and both commercial and US Department of Energy radioactive wastes were compiled, based on the most reliable information available from Government sources and the open literature, technical reports, and direct contacts. Future waste generation rates and characteristics of these materials to be accumulated over the remainder of this century are also presented, based on a present DOE/EIA projection of US commercial nuclear power growth and expected defense-related and industrial and institutional activities. Materials considered, on a chapter-by-chapter basis, are: spent fuel, high-level wastes, transuranic waste, low-level waste, remedial action waste, active uranium mill tailings, and airborne waste. For each category, current and projected inventories are given through the year 2000. The land usage requirements are given for storage/disposal of low-level and transuranic wastes, and for the present inventories of inactive uranium mill tailings.

**34375 (DOE/UMT—0106S) Summary of the engineering assessment of inactive uranium mill tailings, Riverton Site, Riverton, Wyoming.** (Ford, Bacon and Davis Utah, Inc., Salt Lake City (USA)). Aug 1981. Contract AC04-76GJ01658. 57p. (FBDU—360-19S). NTIS, PC A04/MF A01. Order Number DE82000816.

Ford, Bacon, and Davis Utah Inc. has reevaluated the Riverton site in order to revise the December 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Riverton, Wyoming. This engineering assessment has included the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative corrective actions. Radon gas released from the 900,000 tons of tailings materials at the Riverton site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The nine alternative actions presented in this engineering assessment range from millsite decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to remote disposal sites and decontaminations of the tailings site (Options II through IX). Cost estimates for the nine options range from about $16,600,000 for stabilization in-place, to about $23,200,000 for disposal at a distance of 18 to 25 mi. Three principal alternatives for the reprocessing of the Riverton tailings were examined: (a) heap leaching; (b) treatment at an existing mill; and (c) reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be about $260 and $230/lb of $U_3O_8$ by heap leach and conventional plant processes respectively. The spot market price for uranium was $25/lb early in 1981. Therefore, reprocessing the tailings for uranium recovery does not appear to be economically attractive.

**34376 (DP-MS—81-33) Immobilization of high-level waste.** Gould, T.H. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1981. Contract AC09-76SR00001. 32p. (CONF-811108—1). NTIS, PC A03/MF A01. Order Number DE81025595.

From Annual meeting of the Institute of Chemical Engineers; New Orleans, LA, USA (8 Nov 1981).

The development of technology to immobilize high-level radioactive waste into durable solid forms in an ongoing program under the Department of Energy (DOE) Office of Nuclear Waste Management. This program is managed by the DOE Savannah River Operations Office, with technical assistance from the Atomic Energy Division of E. I. duPont de Nemours and Company. Participants in the program include the waste-producing sites, DOE laboratories, industrial laboratories and universities. This paper describes immobilization of high-level waste at Savannah River, summarizes the program to develop waste forms, and reviews the waste form evaluation and selection process.

**34377 (DPSPU—80-30-9) High-current resistance welding of nuclear-waste containers.** Eberhard, B.J.; Kelker, J.W. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Jul 1981. Contract AC09-76SR00001. 19p. (CONF-810404—2). NTIS, PC A02/MF A01. Order Number DE81030403.

From American Welding Society conference; Cleveland, OH, USA (6 Apr 1981).

Various methods are being investigated for permanent disposal of high level nuclear wastes. In one process the waste is incorporated in molten glass and poured into type 304-L stainless steel canisters which provide the first layer of a multilayer containment system. Upset welding was selected as the process best suited for sealing the fill hole in the canister since this process is amenable to use in a remotely operated facility. Welding paramters are readily controlled and dynamically recorded during the course of the weld. Weld quality can be controlled and assessed through control of the pqocess. The process was shown to be suitable for producing welds up to 5 in. (127 mm) in diameter and having 0.38-in. (9.5 mm) throat thickness. Weld current of 230,000 A AC, electrode force of 75,000 lb (333,600 N), and weld time of 2.0 seconds were required for a 5-in. (127 mm) diameter weld. The welds have a wrought structure and the tensile strength of the weld metal equals or exceeds that of the annealed base material. The size weld that can be produced appears limited only by the ability to provide sufficient welding current. A welder designed to deliver 400,000 A DC is being installed in a nonradiioactive nuclear waste pilot facility.

**34378 (DPSTD—80-38) Preliminary technical data summary for the Defense Waste Processing Facility, Stage 1.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Sep 1980. Contract AC09-76SR00001. 213p. NTIS, PC A10/MF A01. Order Number DE82000035.

This Preliminary Technical Data Summary presents the technical basis for design of Stage 1 of the Staged Defense Waste Processing Facility (DWPF), a process to efficiently immobilize the radionuclides in Savannah River Plant (SRP) high-level liquid waste. The radionuclides in SRP waste are present in sludge that has settled to the bottom of waste storage tanks and in crystallized salt and salt solution (supernate). Stage 1 of the DWPF receives washed, aluminum dissolved sludge from the waste tank farms and immobilizes it in a borosilicate glass matrix. The supernate is retained in the waste tank farms until completion of Stage 2 of the

DWPF at which time it filtered and decontaminated by ion exchange in the Stage 2 facility. The decontaminated supernate is concentrated by evaporation and mixed with cement for burial. The radioactivity removed from the supernate is fixed in borosilicate glass along with the sludge. This document gives flowsheets, material, and curie balances, material and curie balance bases, and other technical data for design of the Stage 1 DWPF.

34379 **(KY—712) Denitrification of nitrate-containing heavy-metal-filtrate solutions.** Whinnery, W.N. (Paducah Gaseous Diffusion Plant, KY (USA)). 1 Jul 1981. Contract W-7405-ENG-26. 61p. NTIS, PC A04/MF A01. Order Number DE82000701.

Applying the basis of Oak Ridge Y-12 Plant's development program of biodenitrification of high strength nitrate wastes, the Paducah Gaseous Diffusion Plant (PGDP) has extended that technology to encompass usage of a concentrated nitrate-containing heavy metal filtrate as the feed solution. The results of this paper indicate that while biodenitrification of the PGDP heavy metal wastes has reduced the nitrate concentration from 129,000 ppM to 10 ppM, the rate of denitrification attained in the Y-12 experiments has not been duplicated. Although batch treatment of the heavy metal filtrate proved successful at a low denitrification rate, continuous operation was not accomplished due to the accumulation of heavy metals in the sludge and the high metal content of the feed solution. Effects of the heavy metal solution filtrate as the biodenitrification feed solution are presented in this report in relation to reactor operation and performance. An economic evaluation of a typical plant scale biodenitrification system, using present generation rates, would result in a disposal cost of greater than $250/barrel. Current conditions suggest that sale of this waste to a metals recovery firm or reuse within the Nuclear Division should be explored as an alternative to biodenitrification.

34380 **(MLM—2853(OP)) Use of urethane foam in the decontamination and decommissioning of nuclear facilities.** Hermetz, R.E. (Mound Facility, Miamisburg, OH (USA)). 1981. Contract AC04-76DP00053. 5p. (CONF-811111—1). NTIS, PC A02/MF A01. Order Number DE81028759.

From Society of the Plastics industry's annual technical conference; San Francisco, CA, USA (1 Nov 1981).

Portable equipment for generating urethane foam was used in the decontamination and decommissioning (D & D) of the Plutonium Processing Building at the Mound Facility. The planning and estimating for D & D was based on the procedures outlined below: (1) Clean and remove the interior services, equipment, and any noncritical interior structural members, then prepare and package. (2) Clean all interior surfaces within the enclosure (glovebox) of gross quantities by sweeping and scrubbing. (3) Fix residual quantities of plutonium on interior surfaces with the application of sprayed urethane foam. (4) Clean and remove exterior piping, valves, conduit, and support equipment, then prepare and package. (5) Loosen gloveboxes from their positions, and either cut in two, if too long, or prepare for loading. (6) Load gloveboxes into transuranic (TRU) type shipping containers. (7) Package and stabilize loads within shipping containers by the use of sprayed urethane foam. Procedures 3 and 7 outlined above call for the use of sprayed urethane foam in two different applications: one on the interior surface (Procedure 3) and the other for packaging (Procedure 7). The results so far with sprayed urethane foams have been very favorable. The savings in time and labor will help cut costs and schedule times by 10% overall.

34381 **(ORNL/TM—7524) Use of a phenolic-carboxylic acid cation resin in the treatment of low-level liquid waste at Oak Ridge National Laboratory.** Chilton, J.M. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 18p. NTIS, PC A02/MF A01. Order Number DE82000500.

The loading capacity of CS-100 resin, using plant waste as feed, was found to be significantly reduced after 20 loading-elution cycles; one-fourth or less of the original capacity was retained after 30 cycles. No important differences were noted between an untreated column and a column that had been reconverted to the sodium form in the regeneration step. Omission of the sodium regeneration could not be adopted as a routine procedure because it produced a packing effect in the plant beds; however, reconversion to the sodium form is now achieved by using a stoichiometric amount of caustic rather than a 100% excess, as was previous practice. Since the distribution coefficients for calcium and strontium are about six times greater than that for cesium, no loss of $^{90}Sr$ would be expected while $^{137}Cs$ is loading. Laboratory results obtained by using plant conditions and feed indicate that a typical bed would remove 96% of $^{90}Sr$ in the feed. Cobalt-60 is generally the greatest contributor to the radioactivity of the plant effluent. Laboratory tests indicate that this $^{60}Co$ is present as a mixture of a soluble anionic complex and insoluble colloids. The anionic complex could be removed by placing an anion exchange column in the effluent from the CS-100 resin bed. In studies of the dynamics of loading on CS-100 resin, the contact time in plant operation (3 to 4 min per column volume) was found to be more than adequate to obtain the desired results. Effects of flow velocity were not investigated. Data from a series of laboratory experiments show that CS-100 resin can be eluted satisfactorily with 0.5 to 1.0 M formic or acetic acid, although a larger volume is required than for elution with 0.5 M nitric acid.

34382 **(ORNL/TM—7917) Characterization of materials for waste-canister compatibility studies.** McCoy, H.E.; Mack, J.E. (Oak Ridge National Lab., TN (USA)). Oct 1981. Contract W-7405-ENG-26. 33p. NTIS, PC A03/MF A01. Order Number DE82000902.

Sample materials of 7 waste forms and 15 potential canister materials were procured for compatibility tests. These materials were characterized before being placed in test, and the results are the main topic of this report. A test capsule was designed for the tests in which disks of a single waste form were contacted with duplicate samples of canister materials. The capsules are undergoing short-term tests at 800°C and long-term tests at 100 and 300°C.

34383 **(PNL—3188) Effects of composition on properties in an 11-component nuclear waste glass system.** Chick, L.A.; Piepel, G.F.; Mellinger, G.B.; May, R.P.; Gray, W.J.; Buckwalter, C.Q. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1981. Contract AC06-76RL01830. 120p. NTIS, PC A06/MF A01. Order Number DE81030781.

Ninety simplified nuclear waste glass compositions within an 11-component oxide composition matrix were tested for crystallinity, viscosity, volatility, and chemical durability. Empirical models of property response as a function of glass composition were developed using statistical experimental design and modeling techniques. A new statistical technique was developed to calculate the effects of oxide components on each property. Independent melts were used to check the prediction accuracy of the models.

34384 **(PNL—3512) Survey of matrix materials for solidified radioactive high-level waste.** Gurwell, W.E. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1981. Contract AC06-76RL01830. 58p. NTIS, PC A04/MF A01. Order Number DE82000708.

Pacific Northwest Laboratory (PNL) has been investigating advanced waste forms, including matrix waste forms, that may provide a very high degree of stability under the most severe repository conditions. The purpose of this study was to recommend practical matrix materials for future development that most enhance the stability of the matrix waste forms. The functions of the matrix were reviewed. Desirable matrix material properties were discussed and listed relative to the matrix functions. Potential matrix materials were discussed and recommendations were made for future matrix development. The matrix mechanically contains waste cores, reduces waste form temperatures, and is capable of providing a high-quality barrier to leach waters. High-quality barrier matrices that separate and individually encapsulate the waste cores are fabricated by powder fabrication methods, such as sintering, hot pressing, and hot isostatic pressing. Viable barrier materials are impermeable, extremely corrosion resistant, and mechanically strong. Three material classes potentially satisfy the requirements for a barrier matrix and are recommended for development: titanium, glass, and graphite. Polymers appear to be marginally adequate, and a more thorough engineering assessment of their potential should be made.

34385 **(PNL—3954) Radiation dose rates from commercial PWR and BWR spent fuel elements.** Willingham, C.E. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1981. Contract AC06-76RL01830. 88p. NTIS, PC A05/MF A01. Order Number DE82000697.

Data on measurements of gamma dose rates from commercial reactor spent fuel were collected, and documented calculated gamma dose rates were reviewed. As part of this study, the gamma dose rate from spent fuel was estimated, using computational techniques similar to previous investigations into this problem. Comparison of the measured and calculated dose rates provided a recommended dose rate in air versus distance curve for PWR spent fuel.

34386 **(PNL—3957) Development of in-can melting process and equipment, 1979 and 1980.** Petkus, L.L.; Larson, D.E.; Bjorklund, W.J.; Holton, L.K. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1981. Contract AC06-76RL01830. 46p. NTIS, PC A03/MF A01. Order Number DE82001050.

Nonradioactive process testing continued with the in-can melter as part of an investigation into the applicability of this vitrification process to various calcined high-level and incinerator ash radioactive wastes. The investigation in this report concentrated on how waste composition and canister fins affect in-can melter capacity and how waste composition affects glass quality. Process performance proved to be generally satisfactory. Pilot-scale in-can melter runs were performed with synthetic, nonradioactive, high-level wastes to produce eight canisters of glass. The synthetic wastes processed included high-level wastes from Savannah River, West Valley, and ICPP, as well as transuranic ash waste. Full-scale in-can melter runs using nonradioactive materials were also conducted, producing ten canisters of glass. Of the ten canisters, nine contained Savannah River Plant glass and one canister contained glass from synthetic zirconia calcine waste from the ICPP. 11.4 tons of glass was produced in test runs. In the full-scale in-can melter furnace, the baffles separating the six heating zones were removed because of baffle warping. A remotely operated section connecting the spray calciner to the canister was tested. Some problems were encountered with calcine plugging.

34387 **(PNL—3959) Materials and design experience in a slurry-fed electric glass melter.** Barnes, S.M.; Larson, D.E. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1981. Contract AC06-76RL01830. 194p. NTIS, PC A09/MF A01. Order Number DE82000957.

The design of a slurry-fed electric gas melter and an examination of the performance and condition of the construction materials were completed. The joule-heated, ceramic-lined melter was constructed to test the applicability of materials and processes for high-level waste vitrification. The developmental Liquid-Fed Ceramic Melter (LFCM) was operated for three years with simulated high-level waste and was subjected to conditions more severe than those expected for a nuclear waste vitrification plant.

34388 **(RHO-CD—80-34-4Q) Radioactive liquid wastes discharged to ground in the 200 areas during 1980.** Aldrich, R.C.; Sliger, G.J. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 9 Mar 1981. Contract AC06-77RL01030. 227p. NTIS, PC A11/MF A01. Order Number DE82000041.

This document is tabulated quarterly for the purpose of summarizing the radioactive liquid wastes that have been discharged to the ground in the 200 Areas. In addition to data for 1980, cumulative data since plant startup are presented. Also in this document is a listing of decayed activity to the various plant sites. An overall summary is presented giving the radioactive liquid waste discharged to the ground during the current year of 1980 and since startup (for both total and decayed depositions) with the Rockwell Hanford Operations (Rockwell) control zone (200 Area plateau). Overall summaries are also presented for 200 East and for 200 West Area. The data contain an estimate of the radioactivity discharged to individual periods: (1) all four quarters of 1980; and (2) from startup through December 31, 1980. The location and reference drawings of each disposal site, and the usage dates of each disposal site are given. The estimates for the radioactivity discharged to the ponds also include major nonradioactive streams. The waste discharged during 1980 to each active disposal site is detailed on a month-to-month basis along with the monthly maximum concentration and average concentration data.

34389 **(SAND—81-1293C) Role of benchmarking in assessing the capability to predict room response in bedded salt repositories.** Matalucci, R.V.; Morgan, H.S.; Krieg, R.D. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 22p. (CONF-810861—3). NTIS, PC A02/MF A01. Order Number DE81030817.

From OECD Nuclear Energy Agency workshop on near-field phenomena in geologic respositories for radioactive waste; Seattle, WA, USA (31 Aug 1981).

An overview is presented of the Waste Isolation Pilot Plant (WIPP) Benchmark II study which was used to assess the accuracy and reliability of computer codes used to predict drift response. Emphasis is placed on the objectives and philosophy of Benchmark II and on procedures used to ensure that valid comparisons of results could be made. The problem definition, the selection of participants, and review procedures are all discussed. A sampling of results is also presented to illustrate the degree of variability in the results obtained with various computer codes.

34390 **(SAND—81-1966C) Systems studies of waste transportation.** Allen, G.C.; Cashwell, J.W.; Shirley, C.G.; Vigil, M.G. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-DP00789. 11p. (CONF-811119—2). NTIS, PC A02/MF A01. Order Number DE81030840.

From NWTS program information meeting; Columbus, OH, USA (17 Nov 1981).

The National Waste Terminal Storage transportation technology task being coordinated is a combination of activities directed at both Test and Evaluation Facility (TEF) and future Full Scale Repositories (FSR), however, prime emphasis is being placed on TEF tasks. In response to the redirection of the NWTS program, TTC activities in FY 1982 will focus on transportation of commercial high-level and transuranic waste, although spent fuel will still be considered. Consistent with the TEF and FSR design development schedules, the transportation system and receiving facility interface technology task will receive increased emphasis in FY 1983, while the logistics and NEPA compliance tasks will continue to be major program areas.

34391 **(UCRL—53159) Radiation dose calculations for geologic media around spent fuel emplacement holes in the Climax granite, Nevada Test Site.** Wilcox, T.P.; Van Konynenburg, R.A. (Lawrence Livermore National Lab., CA (USA)). 27 May 1981. Contract W-7405-ENG-48. 86p. NTIS, PC A05/MF A01. Order Number DE82000027.

Lawrence Livermore National Laboratory has emplaced 11 spent nuclear-reactor fuel assemblies in the Climax granite at Nevada Test Site as part of the National Waste Terminal Storage Program. One of the objectives is to study radiation effects on the rock. The neutron and gamma ray doses to the rock are being determined by calculation and measurement. This report discusses calculations performed using the MORSE-L Monte Carlo code to determine dose rates and doses in the materials surrounding the spent fuel assemblies. The initial maximum dose rate to the granite is about 25 mGy/s (9 x $10^3$ rad per hour), and the maximum dose integrated over five years is about 2.2 MGy (220 Mrad). The dose rate is nearly constant over the central 2.44 m of the spent fuel assembly, and drops off approximately exponentially with radius in the granite.

34392 **Method for storing spent nuclear fuel in repositories.** Sastre, C.; Schweitzer, D.G.; Winsche, W. (to Dept. of Energy). US Patent 4,269,728. 26 May 1981. Filed date 21 Aug 1979. vp.

A method for storing radioactive spent fuel in repositories containing sulfur as the storage medium is disclosed. Sulfur is noncorrosive and not subject to radiation damage. Thus, storage periods of up to 100 years are possible.

34393 **Hot air drum evaporator.** Black, R.L. (to Dept. of Energy). US Patent Application 206,232. 12 Nov 1980. 10p.

An evaporation system for aqueous radioactive waste uses standard 30 and 55 gallon drums. Waste solutions form cascading water sprays as they pass over a number of trays arranged in a vertical stack within a drum. Hot dry air is circulated radially of the drum through the water sprays thereby removing water vapor. The system is encased in concrete to prevent exposure to radioactivity. The use of standard 30 and 55 gallon drums permits an inexpensive compact modular design that is readily disposable, thus eliminating maintenance and radiation build-up problems encountered with conventional evaporation systems.

**34394 Sorption of actinides in igneous rocks.** Allard, B.; Beall, G.W.; Krajewski, T. (Oak Ridge Natl Lab, Tenn). *Nuclear Technology ;* **49**: No. 3, 474-480(Aug 1980).

The sorption of americium(III) and neptunium(V) on some major minerals of igneous rocks (quartz, microcline, albite, bytownite, biotite, hornblende, augite, olivine, and kaolinite) and on two granites has been studied, the aqueous phase being on artificial groundwater and with pH varying from four to nine. The sorption was measured on crushed solids (0.044 to 0.063 mm) at ambient temperature by a batch technique, using /sup 241/Am and /sup 235/Np.

**34395 (ORNL-tr—4760) Storage and solidification of MAW/LAW in underground caverns. Second semiannual report 1979.** Boguslawski, Z.; Dumont, E.; Guber, W.; Peters, V.; Zimmer, W. (Oak Ridge National Lab., TN (USA)). Feb 1980. Translation source information not available . 16p. NTIS, PC A02/MF A01. Order Number DE81032014.

The work done during this reporting period was intended to provide information concerning the design of an installation on a commercial scale (yearly output 150 tons of pellets) based on single shift operation of an experimental installation with a daily output of 1 $m^3$ of pellets/day. Simultaneously, a preliminary project was to be worked out for a nuclear installation and the installation costs were to be determined. The pellets produced in the inactive experimental operation with a simplified simulate solution (only $NaNO_3$ as salt material) are to be made available to the other project partners for experimental purposes. The tests were carried out with a drum mixer type FKM. It was determined that the desired values for the salt material of 8% by weight and for the water-cement ratio of 0.2 could initially not be realized with the grain size conveyed ($\leqq$ 5 mm). The corresponding values for salt material were 7.8 wt % and the W/C value was 0.122. A period of 5 minutes is required to produce one batch of pellets (approximately 58 kg). As a means of product characterization, pellet density (2.41 g/$cm^3$), apparent density (1.48 g/$cm^3$), hollow space proportion (38.5%), porosity (22.3%), abrasion resistance (1.22%) and strength (impact test) following hydration (10.4 x $10^{-4}$ $m^3$/J) were measured. A total of 5357 kg of pellets were produced.

**34396 Methods of sodium waste disposal.** Wolson, R.D.; McPheeters, C.C. (ANL). pp 8-20 of Liquid metal technology in energy production. Chicago, IL; American Nuclear Society (1980).

From 2. international symposium on liquid metal technology in energy production; Richland, WA, USA (20 Apr 1980).

Methods are needed to convert waste sodium to a compound suitable for disposal either by landfill or permanent repository storage. The oxidation of sodium to sodium monoxide by calcining was researched. Sodium oxide particles are coated with molten sodium in a rotary-drum reactor. Oxygen is introduced, and reacts to form sodium monoxide. The product was then used as an ingredient in making small quantities of glass having a composition similar to that proposed for radwaste disposal. (2 diagrams, 9 references, 3 tables)

## 0530 Environmental Aspects

*REFER ALSO TO CITATION(S) 34375, 34389, 34394, 34401, 35434, 35469*

**34397 (CONF-811119—1) Disruption scenarios for a nuclear-waste repository on the Nevada Test Site.** Link, R.L.; Bingham, F.W.; Barr, G.E. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 6p. NTIS, PC A02/MF A01. Order Number DE81030844.

From NWTS program information meeting; Columbus, OH, USA (17 Nov 1981).

Scenarios are being constructed for the release of radioactive maerial from hypothetical repositories in different types of rock at NTS. Deductive event trees are constructed; each path through an event tree is a scenario. The complete set of NTS event trees comprises about 340 scenarios, not counting the multiple paths through the subtrees made by expanding complex events. Each of these scenarios is being analyzed for 10 different types of rocks. (DLC)

**34398 (DOE/EIS—0082D) Draft envirnmental impact statement: Defense Waste Processing Facility, Savannah River Plant, Aiken, SC.** (USDOE Assistant Secretary for Nuclear Energy, Washington, DC. Office of Nuclear Waste Management and Fuel Cycle Programs). Sep 1981. 456p. NTIS, PC E05/MF E05. Order Number DE81030992.

The purpose of this Environmental Impact Statement (EIS) is to provide environmental input into both the selection of an appropriate strategy for the permanent disposal of the high-level radioactive waste (HLW) currently stored at the Savannah River Plant (SRP) and the subsequent decision to construct and operate a Defense Waste Processing Facility (DWPF) at the SRP site. The SRP is a major US Department of Energy (DOE) installation for the production of nuclear matrials for national defense. Approximately 83 x $10^3$ $m^3$ (22 million gal) of HLW currently are stored in tanks at the SRP site. The proposed DWPF would process the liquid HLW generated by SRP operations into a stable form for ultimate disposal. This EIS assesses the effects of the proposed immobilization project on land use, air quality, water quality, ecological systems, health risk, cultural resources, endangered species, wetlands protection, resource depletion, and regional social and economic systems. The radiological and nonradiological risks of transporting the immobilized wastes are assessed. The environmental impacts of disposal alternatives have recently been evaluated in a previous EIS and are therefore only summarized in this EIS.

**34399 (DOE/TIC—11491) Hydrologic study of the unsaturated zone adjacent to a radioactive-waste disposal site at the Savannah River Plant, Aiken, South Carolina.** Gruber, P. (Oak Ridge Associated Universities, Inc., TN (USA); Georgia Univ., Athens (USA)). 1980. Contract AC05-76OR00033. 136p. NTIS, PC A07/MF A01. Order Number DE81031984.

Thesis.

Unsaturated hydraulic conductivity as a function of soil-water content and soil-water pressure head of field soils in the vicinity of a low-level radioactive-waste disposal site was measured for a period of 28 days following steady-state infiltration. Tensiometer and a neutron probe measurements were replicated four times at various depth intervals of from 12.0 to 120.00 inches below land surface in two 12 foot square plots. Values of soil-water content, soil-water flux, and hydraulic conductivity at each depth were calculated during the period of drainage using a computer program called SOIL. After drainage of soil-water through the 120 inch profile ceased, duplicate undisturbed soil cores from opposite sides of each plot and from disturbed and undisturbed sites within the burial grounds were recovered and subjected to pressure-plate analysis for the calculation of unsaturated hydraulic conductivity. Laboratory analyses also included the determination of soil bulk density, particle-size distribution, and saturated hydraulic conductivity. Calculation of unsaturated hydraulic conductivity in the laboratory was made using a computer program called HYDRO, based upon the relationship of the soil-water content/soil-water pressure curve. Soils in the study area and the burial ground exhibited similar physical and hydrologic characteristics. Field derived hydraulic conductivity correlated well with laboratory derived conductivity. Variability of soil characteristics due to burial operations were minimal when compared to undisturbed natural soils in the study area. Two textural discontinuities were found to exist in the soil profile at depths of 12 to 24 inches and at 130 inches, which inhibit soil-water

movement and thereby reduce the quantity and rate of recharge to the underlying water-table aquifer.

34400 **(DOE/UMT—0106) Engineering assessment of inactive uranium mill tailings, Riverton site, Riverton, Wyoming.** (Ford, Bacon and Davis Utah, Inc., Salt Lake City (USA)). Aug 1981. Contract AC04-76GJ01658. 176p. (FBDU—360-19). NTIS, PC A09/MF A01. Order Number DE82000817.

Ford, Bacon and Davis Utah Inc. has reevaluated the Riverton site in order to revise the December 1977 engineering assessment of the problems resulting from the existence of radioactive uranium mill tailings at Riverton, Wyoming. This engineering assessment has included the preparation of topographic maps, the performance of core drillings and radiometric measurements sufficient to determine areas and volumes of tailings and radiation exposures of individuals and nearby populations, the investigations of site hydrology and meteorology, and the evaluation and costing of alternative corrective actions. Radon gas released from the 900,000 tons of tailings materials at the Riverton site constitutes the most significant environmental impact, although windblown tailings and external gamma radiation also are factors. The nine alternative actions presented in this engineering assessment range from millsite decontamination with the addition of 3 m of stabilization cover material (Option I), to removal of the tailings to remote disposal sites and decontamination of the tailings site (Options II through IX). Cost estimates for the nine options range from about $16,600,000 for stabilization in-place, to about $23,200,000 for disposal at a distance of 18 to 25 mi. Three principal alternatives for the reprocessing of the Riverton tailings were examined: heap leaching; treatment at an existing mill; and reprocessing at a new conventional mill constructed for tailings reprocessing. The cost of the uranium recovered would be about $260 and $230/lb of $U_3O_8$ by heap leach and conventional plant processes, respectively. The spot market price for uranium was $25/lb early in 1981. Therefore, reprocessing the tailings for uranium recovery does not appear to be economically attractive.

## 0540 Health And Safety

*REFER ALSO TO CITATION(S) 34364, 34375, 34385, 34949, 35447*

34401 **(DP—1598) In-situ high-resolution gamma-spectrometric survey of burial ground-monitoring wells.** Bowman, W.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Sep 1981. Contract AC09-76SR00001. 40p. NTIS, PC A03/MF A01. Order Number DE81030827.

In situ high resolution gamma-ray spectrometry with an intrinsic germanium detector assembly of special design surveyed the burial ground monitoring wells to locate and identify gamma emitters that may have migrated from the burial trenches toward the water table. Gamma-ray spectra were acquired as a function of depth in each well and recorded on magnetic tape. These spectra were reduced by a series of computer programs to produce count rate versus depth profiles for natural and man-made activities. The original spectra and the profiles have been archived on magnetic tape for comparison with similar future surveys. Large amounts of man-made activities were observed in some of the burial trenches; however, below the trench bottoms, only very low but detectable amounts of $^{60}Co$ and $^{137}Cs$ were observed in eleven wells. The highest level of man-made gamma activity observed below the trench bottoms has a count rate roughly equal to that observed for uranium daughter activities which are natural to the subsoil.

34402 **(ORNL/TM—7984) Methods and procedures for external radiation dosimetry at ORNL.** Gupton, E.D. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 95p. NTIS, PC A05/MF A01. Order Number DE82000520.

Procedures, methods, materials, records, and reports used for accomplishing the personnel, external radiation monitoring program at Oak Ridge National Laboratory are described for the purpose of documenting what is done now for future reference. This document provides a description of the methods and procedures for external radiation metering, monitoring, dosimetry, and records which are in effect at ORNL July 1, 1981. This document does not include procedures for nuclear accident dosimetry except insofar as routine techniques may apply also to nuclear accident dosimetry capability.

## 0550 Regulations

*REFER ALSO TO CITATION(S) 34359, 34380*

34403 **(ENICO—1096) Automated transportable mass spectrometer.** Echo, M.W. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Sep 1981. Contract AC07-79ID01675. 45p. NTIS, PC A03/MF A01. Order Number DE82000903.

The need has been identified for a Mass Spectrometer (MS) which can be conveniently transported among several facilities for rapid verification of the isotopic composition of Special Nuclear Material. This requirement for a light weight, transportable MS for U and Pu mass analysis was met by deleting the gas chromatograph (GC) portions of a Hewlett-Packard (H-P) Model 5992 Quadrupole GCMS and substituting a vacuum lock sample entry system. A programmable power supply and vacuum gauge were added and circuitry modifications were made to enable use of the supplied software. The single rhenium filament plug-in source is loaded with either a nominal microliter of sample solution and evaporated, or with a prepared resin bead. Using a resin bead in a specially dimpled filament, copious sensitivity is obtained with 30 nanogram uranium samples. After sample insertion the analysis is completely controlled by an H-P Model 9825 calculator. Source vacuum of $2 \times 10^{-7}$ torr or better is regained within 2 minutes after sample insertion, and total time for a complete analysis is about 7 minutes. Accuracy is better than 1% for isotope ratios less than 20 and better than 2% for ratios of 100. Ions are accelerated at about 1.8 volts into the mass filter which has pole pieces of hyperbolic cross section. Collection is by a Galileo Channeltron multiplier into a log preamp. During a normal run, $1.4 \times 10^6$ data point are observed and averaged. Weight of the instrument excluding the calculator is 88 Kg which allows relatively easy transportation over short distances by two persons. The instrument can be carried into a facility and be ready to analyze samples in less than 3 hours.

# 06 FUSION FUELS

## 0602 Processing

34404 **(LA-UR—81-2722) Preparation of multishell ICF target plastic-foam cushion materials by thermally induced phase-inversion processes.** Young, A.T.; Moreno, D.K.; Marsters, R.G. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 18p. (CONF-811113—10). NTIS, PC A02/MF A01. Order Number DE82000574.

From American Vacuum Society national symposium; Anaheim, CA, USA (3 Nov 1981).

Homogenous, low-density plastic foams for ICF targets have been prepared by thermally induced phase inversion processes. Uniform, open cell foams have been obtained by the rapid freezing of water solutions of modified cellulose polymers with densities in the range of 5 mg/cm$^3$ to 0.7 mg/cm$^3$ and respective average cell sizes of 2 to 40 micrometers. In addition, low-density, microcellular foams have been prepared from the hydrocarbon polymer poly(4-methyl-l-pentene) via a similar phase inversion process using homogenous solutions in organic solvents. These foams have densities from 2 to 5 mg/cm$^3$ and average cell sizes of 20 micrometers. The physical-chemical aspects of the thermally induced phase inversion process is presented.

34405 **(UCRL—86114) Copper-coated laser-fusion targets using molecular-beam levitation.** Rocke, M.J. (Lawrence Livermore National Lab., CA (USA)). 8 Sep 1981. Contract W-7405-ENG-48. 14p. (CONF-811113—11). NTIS, PC A02/MF A01. Order Number DE82000644.

From American Vacuum Society national symposium; Anaheim, CA, USA (3 Nov 1981).

A series of diagnostic experiments at the Shiva laser fusion facility required targets of glass microspheres coated with 1.5 to 3.0 μm of copper. Previous batch coating efforts using vibration tech-

niques gave poor results due to microsphere sticking and vacuum welding. Molecular Beam Levitation (MBL) represented a noncontact method to produce a sputtered copper coating on a single glassmicrosphere. The coating specifications that were achieved resulted in a copper layer up to 3 μm thick with the allowance of a maximum variation of 10 nm in surface finish and thickness. These techniques developed with the MBL may be applied to sputter coat many soft metals for fusion target applications.

34406 **(UCRL—86184) Metal-containing plasma-polymerized coatings for laser-fusion targets.** Letts, S.A.; Jordan, C.W. (Lawrence Livermore National Lab., CA (USA)). 14 Sep 1981. Contract W-7405-ENG-48. 9p. (CONF-811113—9). NTIS, PC A02/MF A01. Order Number DE82000346.

From American Vacuum Society national symposium; Anaheim, CA, USA (3 Nov 1981).

Addition of metal to plastic layers in some direct drive laser fusion targets is needed to reduce electron induced fuel preheat. A plasma polymerization coating system was constructed to produce a metal seeded polymer by adding an organometallic gas to the usual trans-2-butene and hydrogen feedstocks. Since organometallic gases are highly reactive and toxic, safety is a major concern in the design of a coating system. Our coating apparatus was designed with three levels of containment to assure protection of the operator. The gas handling system has redundant valves and was designed to fail safe. Several sensor controlled interlocks assure safe operating conditions. Waste materials are collected on a specially designed cold trap. Waste disposal is accomplished by heating the traps and purging volatile products through a reactor vessel. The design, operating procedure, and safety interlocks of this novel coating system are described.

34407 **(UCRL—86185) Automatic gas-levitation system for vacuum deposition of laser-fusion targets.** Jordan, C.W.; Cameron, G.R.; Krenik, R.M.; Crane, J.K. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 8 Sep 1981. Contract W-7405-ENG-48. 13p. (CONF-811113—8). NTIS, PC A02/MF A01. Order Number DE82000296.

From American Vacuum Society national symposium; Anaheim, CA, USA (3 Nov 1981).

An improved simple system has been developed to gas-levitate microspheres during vacuum-deposition processes. The automatic operation relies on two effects: a lateral stabilizing force provided by a centering-ring; and an automatically incremented gas metering system to offset weight increases during coating.

34408 **High density laser-driven target.** Lindl, J.D. (to Dept. of Energy). US Patent 4,272,320. 9 Jun 1981. Filed date 3 Nov 1977. vp.

A high density target for implosion by laser energy composed of a central quantity of fuel surrounded by a high-z pusher shell with a low-z ablator-pusher shell spaced therefrom forming a region filled with low-density material.

34409 **Apparatus for producing cryogenic inertially driven fusion targets.** Miller, J.R. (to Dept. of Energy). US Patent 4,266,506. 12 May 1981. Filed date 25 Jan 1978. vp.

A new technique for producing uniform layers of solid dt on microballoon surfaces. Local heating of the target, typically by means of a focused laser, within an isothermal freezing cell containing a low pressure cryogenic exchange gas such as helium, vaporizes the dt fuel contained within the microballoon. Removal of the laser heating source causes the dt gas to rapidly condense and freeze in a layer which exhibits a good degree of uniformity.

### 0603 By-products

34410 **(EPRI-ER—248) Enhanced energy utilization from a controlled thermonuclear fusion reactor. Final report.** Eastlund, B.J. (Fusion Systems Corp., Rockville, MD (USA)). Sep 1976. 109p. NTIS, PC A06/MF A01. Order Number DE82900200.

Applications of the unique forms of fusion energy to synthetic fuel production, chemical manufacturing, and materials processing have been studied. Computer codes were developed to permit quantitative calculation of the enhancement of energy utilization efficiency for multipurpose tokamak and mirror reactors. Production of synthetic portable fuels such as hydrogen or methane by neutron radiolysis is identified as the most important near term application. Fuel production offers large advantages for low Q, high circulating power systems such as mirrors, small tokamaks, theta pinches, and laser pellet reactors. It offers little advantage to high Q, high thermal efficiency systems typified by large tokamaks. It is shown that a small, 5 meter long mirror could produce net useful energy at 6.5% efficiency and could be operational by 1986. It is recommended that research begin immediately on 14 MeV neutron radiolysis as well as on blankets designed for radiolytic production of fuel. General descriptions are given of the unique energy forms of a fusion reactor as well as the many processes that these energy forms could promote.

## 07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

### 0701 Physical Isotope Separation

*REFER ALSO TO CITATION(S) 34352*

### 0702 Radiation Sources

*REFER ALSO TO CITATION(S) 35577*

34411 **(CONF-810969—1) Radioisotopes distributed for industrial applications for Oak Ridge National Laboratory.** Lamb, E. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01. Order Number DE81030811.

From IAEA conference; Grenoble, France (28 Sep 1981).

A brief discussion is presented of the radioisotopes distributed by ORNL, available quantities, and their main areas of industrial applications. (DLC)

### 0703 Isotopic Power Supplies

*REFER ALSO TO CITATION(S) 34411, 35002, 35003, 35445*

34412 **(DOE/SF/01123—T57) Executive summary: Brayton isotope power system.** (AiResearch Mfg. Co., Phoenix, AZ (USA)). 15 Mar 1978. Contract AC03-76SF01123. 34p. NTIS, PC A03/MF A01. Order Number DE81027473.

The status and program plans for the DOE program to design and develop a long-life, safe Brayton isotope power system for space power are described. (WHK)

## 08 HYDROGEN

*REFER ALSO TO CITATION(S) 35107*

### 0801 Production

*REFER ALSO TO CITATION(S) 34410, 35292*

34413 **(LA-UR—81-2627) Experimental work related to two bismuth sulfate cycles and their possible improvement. Outline of a possible antimonyl sulfate cycle with separate evolution of sulfur dioxide and oxygen.** Jones, W.M. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 10p. (CONF-810942—4). NTIS, PC A02/MF A01. Order Number DE81030236.

From International Energy Agency Annex I workshop on thermochemical hydrogen; Julich, F.R. Germany (23 Sep 1981).

Two bismuth sulfate cycles are made possible by the stepwise decomposition of the sulfate-oxysulfate system. Omitting statement of the steps for decomposition of $SO_3$ and the electrochemical formation of $H_2$ and $H_2SO_4$ from $SO_2$ and $H_2O$, the key reactions

are: Cycle I - $Bi_2(SO_4)_3 = Bi_2O_{2.3}(SO_4)_{0.7} + 2.3\ SO_3$; $Bi_2O_{2.3}(SO_4)_{0.7} + 2.3\ H_2SO_4 = Bi_2(SO_4)_3 + 2.3\ H_2O$; Cycle II - $Bi_2O(SO_4)_2 = Bi_2O_{2.3}(SO_4)_{0.7} + 1.3\ SO_3$; $Bi_2O_{2.3}(SO_4)_{0.7} + 1.3\ H_2SO_4 = Bi_2O(SO_4)_2 + 1.3\ H_2O$. Cycle I proceeds through the intermediate oxysulfates $Bi_2O(SO_4)_2$ and $Bi_2O_2SO_4$ and Cycle II through $Bi_2O_2SO_4$. Cycle I has the advantage of generating 2.3 moles of $H_2$ per mole of $Bi_2O_3$, compared with 1.3 for Cycle II. Published work on the $Bi_2O_3$-$SO_3$-$H_2O$ system shows that $Bi_2(SO_4)_3$ is the stable solid in contact with $H_2SO_4$ solutions above 52.7 wt%, so that acid of at least this strength would have to be used in Cycle I. Concentrations between about 3 wt% and 52.7 wt% could be used for Cycle II. The efficiency for electrochemical formation of $H_2SO_4$ and $H_2$ seems at present to be a maximum at around 30 wt% $H_2SO_4$. Some thermodynamic data obtained for the decomposition reactions are presented. A possible improvement in these cycles is also discussed which may provide a solution to a problem of sorption of $H_2SO_4$ solution by the solids and might allow use of a more dilute acid than in Cycle I above. A brief discussion on the possible simplification of the $SO_3$-$SO_2$-$O_2$ separation problem with a sulfuric acid-antimonyl sulfate hybrid cycle is presented. The principal reactions are: (1) $Sb_2O_2SO_4 = Sb_2O_4 + SO_2$ at 900 K; (2) $Sb_2O_4 = Sb_2O_3 + 1/2\ O_2$ at 1300 K; (3) $Sb_2O_3 + H_2SO_4 = Sb_2O_2SO_4 + H_2O$.

34414 **(UCID—19192) Behavior of alkali metal-acid phosphates during elevated temperature water electrolysis.** Steinbugler, M. (Lawrence Livermore National Lab., CA (USA)). 19 Aug 1981. Contract W-7405-ENG-48. 14p. NTIS, PC A02/MF A01. Order Number DE82000243.

We are exploring the use of molten salts containing water as electrolytes for the high temperature (~ 300 to 400°C) electrolysis of water as part of a research program on Thermochemical Cycles for the Production of Hydrogen. The purpose of this study is to determine the behavior of the phosphate-based electrolytes $KH_5(PO_4)_2$, $LiH_5(PO_4)_2$, and $NaH_5(PO_4)_2$, during electrolysis. We are most interested in their characteristics as a function of temperature, the degree of dehydration, and effects of neutralizing cations. We observed the behavior of these molten salts while measuring the cell potential as a function of time at constant current densities up to 1 $A/cm^2$ using platinum electrodes. We also monitored the cell resistance before and after polarization in order to correlate the electrolyte conductivity to the degree of dehydration. Our experiments demonstrated several important characteristics of the electrolytes. Perhaps the most obvious characteristic is the tendency to dehydrate in an open container. This loss of water increases the potential for any given current and temperature for each electrolyte. It does so primarily be increasing the resistance of the electrolyte. This dehydration effect was most pronounced in the sodium- and lithium-based electrolytes, with the potassium-based electrolytes showing a relatively slow dehydration rate. However, the resistances for the sodium-based electrolytes were generally lower than for the potassium-based electrolytes when the water content was high. The lowest cell potentials were obtained for the sodium-based electrolyte at 300 and 350°C. However, any conclusions based on our cell potential measurements are of limited value at this time due to the qualitative nature of our experiments especially in regard to the uncertainties in water contents of the melts.

34415 **Homogeneous catalysis of the water gas shift reaction with the use of groupd 6 transition metal carbonyls: $Cr(CO)_6$, $Mo(CO)_6$, and $W(CO)_6$.** Kind, A.D. Jr.; King, R.B.; Yang, D.B. (Univ. of Georgia, Athens). Contract EY-76-S-09-0933. *Journal of the American Chemical Society ;* **103**: No. 10, 2699-2704(20 May 1981).

Measurements have been carried out to determine the rate of hydrogen production by the water gas shift reaction ($CO + H_2O \rightarrow CO_2 + H_2$) operating at temperatures of 200°C and lower with hexacarbonyls of chromium, molybdenum, and tungsten serving as catalyst precursors in basic methanol-water solutions. The catalytic behavior of each of these systems is similar and turnover numbers as great as 12,000 mol of $H_2$/mol of metal hexacarbonyl per day can be achieved at 200°C. The rate of hydrogen production is found to be (a) proportional to the amount of metal hexacarbonyl present in the system, (b) inversely proportional to carbon monoxide pressure; and (c) increasing with base concentration. Under conditions of constant base concentration and pressure, the temperature dependence of this reaction is found to be quite similar for each system corresponding to activation energies of 35, 35, and 32 kcal/mol for $Cr(CO)_6$, $Mo(CO)_6$, and $W(CO)_6$, respectively. The overall kinetics of this reaction can be explained by a mechanism involving formate decomposition rather than activation of carbon monoxide.

34416 **Catalytic cartridge $SO_3$ decomposer.** Galloway, T.R. (to Dept. of Energy). US Patent Application 208,218. 18 Nov 1980. 8p.

A catalytic cartridge surrounding a heat pipe driven by a heat source is utilized as a $SO_3$ decomposer for thermochemical hydrogen production. The cartridge has two embodiments, a cross-flow cartridge and an axial flow cartridge. In the cross-flow cartridge, $SO_3$ gas is flowed through a chamber and incident normally to a catalyst coated tube extending through the chamber, the catalyst coated tube surrounding the heat pipe. In the axial-flow cartridge, $SO_3$ gas is flowed through the annular space between concentric inner and outer cylindrical walls, the inner cylindrical wall being coated by a catalyst and surrounding the heat pipe. The modular cartridge decomposer provides high thermal efficiency, high conversion efficiency, and increased safety. A fusion reactor may be used as the heat source.

## 0802 Storage

*REFER ALSO TO CITATION(S) 34417*

## 0803 Transport

*REFER ALSO TO CITATION(S) 34248*

## 0804 Marketing And Economics

*REFER ALSO TO CITATION(S) 34417*

## 0805 Safety

*REFER ALSO TO CITATION(S) 34417*

## 0806 Industrial And Commercial Use

34417 **Liquid hydrogen as a vehicular fuel: an evaluation.** Stewart, W.F.; Edeskuty, F.J. (Los Alamos Sci Lab, NM). *Mechanical Engineering ;* **103**: No. 5, 24-29(May 1981).

The U.S. Department of Energy Division of Transportation Energy Conservation, the Los Alamos Scientific Laboratory (LASL), the New Mexico Energy Institute (NMEI), and the Deutsche Forschungs und Versuchsanstalt fur Luft und Raumfahrt (DFVLR) are jointly participating in an effort to study the problems involved in fueling automobiles with liquid hydrogen, to demonstrate a vehicle of conventional appearance and performance operating on liquid hydrogen, and to demonstrate a liquid hydrogen refueling station that can be operated by personnel with minimal training. The NMEI is providing the vehicle, and the DFVLR is providing both the liquid hydrogen fuel tank and a liquid hydrogen refueling station for this project. 8 refs.

## 0808 Properties

*REFER ALSO TO CITATION(S) 34973*

## 0809 Environmental Aspects

*REFER ALSO TO CITATION(S) 34248*

# 09 OTHER SYNTHETIC AND NATURAL FUELS

*REFER ALSO TO CITATION(S) 34522*

## 0901 Hydrocarbon Fuels

*REFER ALSO TO CITATION(S) 34454, 34513, 34517, 35178, 35254, 35269, 35460*

**34418 (ANL/CNSV—23) State of the art of methane gas enhancement in landfills.** (Argonne National Lab., IL (USA); EMCON Associates, San Jose, CA (USA)). Jun 1981. Contract W-31-109-ENG-38. 70p. NTIS, PC A04/MF A01. Order Number DE82000155.

The objectives of this report are to (a) summarize the state of the art of gas generation in a sanitary landfill, and (b) describe techniques of methane production. The energy content of landfill gas is due to the presence of methane. Therefore, methane enhancement involves optimizing conditions that increase the yield and rate of methane production within the landfill. Of great importance to the effective design and operation of landfill gas recovery systems are certain parameters that affect the lag time, yield, and rate of production of landfill-generated methane. These enhancement parameters include moisture content, pH buffering of the aqueous phase, nutrient addition, bacterial seeding, particle size, and density of refuse. Laboratory and field observations suggest than an increase in moisture content, coupled with buffering by a pH of 7 and the addition of nutrients and bacteria, will result in a shorter lag time while increasing both the yield and rate of methane generation. Work performed to date, however, does not enable quantifying functional relationships between the methanegenic process and its parameters. Such quantitative data are needed to predict overall process dynamics and optimize the design of any recovery system.

**34419 (BNL—51423) Development of catalytic systems for the conversion of syngas to jet fuel and diesel fuel and higher alcohols. Annual report.** Slegeir, W.A. (Brookhaven National Lab., Upton, NY (USA)). Oct 1980. Contract AC02-76CH00016. 18p. NTIS, PC A02/MF A01. Order Number DE82000067.

Highlights of the year's research activities are reported. A highly active series of Fischer-Tropsch catalysts were developed during FY 1980, on the basis of insights provided by the oxide theory. The method of catalyst formulation is unique in Fischer-Tropsch chemistry, yet is simple and reproducible. These catalysts offer the promise of being superior to ordinary catalysts for hydrocarbon synthesis with regard to rate, operating conditions, and, quite possibly, product selectivity and longevity. The products of these catalysts appear to be ideally suited for use as diesel and jet fuels. Once formed, the catalysts display remarkable stability toward air. Specific descriptions of catalyst preparations and composition of matter must be withheld pending patent protection. Also during FY 1980, an exploratory program was directed toward achieving a better understanding of support effects, oxide interactions, the role of promoters, and the synergistic behavior of bimetallic catalysts systems. Some results dealing with bimetallic systems for hydrocarbon and alcohol synthesis are discussed.

**34420** (CONF-801030—(Vol.1), pp 171-177) **Biogas in India: retrospects and prospects.** Sood, D.K. (PRC Energy Analysis Co., McLean, VA). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

India is one of the few developing countries which have attempted utilizing biogas in a large number of rural areas. In these areas, biogas technology reconciles two seemingly conflicting functions; using cattle dung and other organic material both as fuel and as fertilizer for agricultural production. Biogas energy systems have the potential of significantly meeting fuel and fertilizer needs of rural India. To date, almost 74,000 biogas plants have been built. This development has, however, highlighted several problems likely to be faced in realizing the full potential of biogas energy systems in India. This paper attempts to describe the growth of biogas technology in the light of various issues involved, as well as their impacts on the prospects of biogas generation in India.

**34421** (CONF-801030—(Vol.1), pp 191-197) **Gasification of lignocellulosics for methanol production.** Yang, V.; Trindade, S.C. (Centro de Tecnologia Promon, Rio de Janeiro, Brazil). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The status of the Brazilian alcohol program is reviewed. Diversification strategies for the production of liquid fuels are discussed. The gasification of lignocellulosics for methanol production is described. Several critical parameters determine the gas composition and the performance of a gasifier for lignocellulosics. Among these, temperature, pressure and the gasification agent have pronounced effects on any proposed gasifier. At high temperatures and low pressure, syngas dominates the equilibrium gas composition. In the opposite extreme of mild to low temperatures and medium to higher pressures, methane formation has a favorable equilibrium. The choice of the gasifier operating pressure hinges on factors, in addition to thermodynamics. If the gas derived from gasification of lignocellulosics is to be used as syngas for fuel methanol, process energy efficiency becomes of paramount importance. Our results indicate that atmospheric gasification may lead to unaffordable energy costs for gas compression, even considering methanol synthesis at 50 atm - the lowest pressure level based on commercial technology. Lignocellulosics such as wood are typically deficient in hydrogen compared with methanol. Water is the most abundant source of hydrogen and hence it is a prime candidate as the gasification agent. The potential of water as steam to gasify wood is reinforced by available experimental evidence, suggesting a more favorable kinetics compared with coal steam gasification.

**34422 (DOE/CS/83004—3) Development of hydroconversion of biomass to synthetic fuels. Project 61042 technical progress report, January 1-March 31, 1981.** (Institute of Gas Technology, Chicago, IL (USA)). Jul 1981. Contract AC02-80CS83004. 56p. NTIS, PC A04/MF A01. Order Number DE81030954.

The work accomplished during this quarter is summarized. The complete physical and chemical characterization data for Douglas fir hog fuel, maple hardwood, and corn stover are presented for comparison. Fluidization parameters were obtained for mixtures of char and hollow alumina spheres (-25 + 60 mesh) as the inert bed material. The drying characteristics of maple hardwood were measured isothermally in the range of 200° to 400°F. Three distinct moisture content regions were observed with different characteristic drying behavior. Size reduction characteristics were studied in a small hammermill and showed that the throughput rate for various product screen sizes was lower for the moist, as-received feed than for the dried feed material. The analysis of the hydrodevolatilization data of maple hardwood from the rapid heat-up rate, free-fall apparatus was completed. The devolatilization of the maple hardwood occurred within the 0.3-second residence time in the apparatus in the presence of hydrogen at about 1200°F. The conversion increased from 65% to 88% for various hydrogen pressures from 0 psia (i.e., helium) to 200 psia. A comparison made between the steam-char gasification rates of coal, peat, and maple hardwood chars shows that the reactivity level expected of the biomass char is significantly higher than that of coal and peat. Work has proceeded with engineering design and specification of supporting and auxiliary systems. The data obtained in the first three support tasks were used to review the pertinent areas of the PDU design and operating conditions. The char and inert material mixtures' fluidization data, the devolatilization data, and the steam-char gasification data confirmed the chosen PDU process design values and operating conditions. The product yields for an adiabatic PDU gasifier have been calculated with the most recent data for maple hardwood containing 10% moisture.

**34423 (DOE/EV/02161—T1) Energy generation and the sulfur-carbon cycle. Progress report.** (Wisconsin Univ., Madison (USA). Dept. of Bacteriology). 1981. Contract AS02-76EV02161. 3p. NTIS, PC A02/MF A01. Order Number DE81030949.

Laboratory studies demonstrated that a variety of anaerobic bacterial species actively reduced dimethylsulfoxide as an electron acceptor while oxidizing organic substrates as electron donors during growth. The microbial decomposition of methionine in anaerobic Lake Mendota sediments, methanethiol and dimethylsulfide were detected as intermediates; whereas, methane, carbon dioxide, and hydrogen sulfide were the final end products of anaerobic decomposition. Dimethylsulfide and methylmercaptan were immediate methane precursors in Lake Mendota sediments. The oxidation of methane by anaerobic bacteria and characterization of an acetate fermenting methanogenic bacterium were studied. Cultures of methanogenic bacteria demonstrated that methanogens converted $^{14}CH_4$ to $^{14}CO_2$ by a pathway that involved different cellular intermediates than those involved in methane production. The general physiological properties of an acetate fermenting methanogen isolated from sewage sludge was characterized. Most notably, this species would not grow on $H_2 + CO_2$. Studies on the influence of sulfate metabolism on carbon turnover in Lake Mendota suggested that approximately 50% of the reduced endogenous carbon was mineralized via sulfate reduction and 50% via methanogenesis. Most of the endogenous carbon mineralized via sulfate reduction occurred in the surface sediments. Sulfate reduction was not limited by in situ sulfate concentration in surface sediments. Studies on biopolymer decomposition showed in situ turnover rate constants for $^{14}C$-pectin of 0.11 $h^{-1}$ in Lake Mendota sediments and 0.004 $h^{-1}$ in Knaack Lake. The number of anaerobic pectin degrading bacteria in the sediments of both lakes varied with seasons. (ERB)

34424 (LBL—11983, pp 3.13-3.15) **LBL biomass liquefaction process.** Davis, H.; Ergun, S.; Figueroa, C.; Karatas, C.; Schaleger, L.; Yaghoubzadeh, N. Mar 1981. NTIS, PC A03/MF A01. Order Number DE81030532.

In Chemical process research and development program, FY 1980.

The major objective of this program is to provide a process for converting Douglas fir wood, and other sources of biomass, to a commercially usable fuel oil. A process development unit (PDU) is operated on a Department of Energy (DOE) contract at Albany, Oregon by Rust Engineering. It has been able to generate significant amounts of oil product from Douglas fir wood chips since late 1979. The PERC process, as used in the PDU, requires excessive recycle of product oil - 10 parts or more of recycled oil to one part dry wood feed - and has other economic deficiencies. The LBL process was designed to correct these deficiencies. Actually, the first substantial amounts of product in the PDU were made by an improvised version of the LBL process. Two relatively successful PERC-mode runs were accomplished in June and October 1980. Progress made in slurry preparation and stability, continuous operation, and batch operation is discussed. Planned activities for 1981 are outlined. (DMC)

34425 (LBL—11983, pp 3.15-3.18) **Chemistry of biomass liquefaction.** Davis, H.; Kloden, D.; Schaleger, L. Mar 1981. NTIS, PC A03/MF A01. Order Number DE81030532.

In Chemical process research and development program, FY 1980.

The LBL process for the liquefaction of wood is described. A study of the stoichiometry and mechanism of the conversion and the chemical make-up of the product was undertaken. Accomplishments during 1980 are summarized. The gross product of liquefaction has been characterized by elemental analysis, simple physical properties, and distillation. A list of products identified by steam distillation of an LBL process product is included. (DMC)

34426 (LBL—11983, pp 3.18-3.20) **Solvolysis of Douglas fir wood in acidified organic solvents.** Yu, G.; Vermeulen, T.; Davis, H. Mar 1981. NTIS, PC A03/MF A01. Order Number DE81030532.

In Chemical process research and development program, FY 1980.

There are two major engineering and economic problems of wood liquefaction. These arise from the difficulty of feeding the substrate into a reaction system (the front end problem) and the need for a reaction temperature near the critical temperature of water, and consequently for a high operating pressure. The front end problem is currently met by feeding a liquid and biomass slurry. This is wood flour-recycle product oil in the PERC process and prehydrolyzed wood-water in the LBL process. The objective of the present work was to find an alternate method of liquefying wood to solve the front-end problem by producing a material easily fed into a liquefaction reactor that might yield an interesting product, thereby totally by-passing the present liquefaction reaction system. Based on wood chemistry concepts, a process capable of solubilizing more than 95% of wood under some mild conditions has been developed. Unlike the PERC and LBL processes, no $H_2$ or CO is required. The product is a soft, black, bitumen-like solid at room temperature and melts readily at 140°C. Its heating value is estimated to be roughly 11,000 Btu/lb.

34427 **(MASEC/R—81-068) Interactive model to assess economics of anaerobic digestion on the farm.** (Mid-America Solar Energy Center, Minneapolis, MN (USA)). Aug 1981. Contract AC02-79CS30150. 41p. (B—102-3). NTIS, PC A03/MF A01. Order Number DE82000452.

This interactive computer model was designed to provide economic assessment for on-the-farm anaerobic digestion systems. The model is accessed as part of the MASEC Models Library, a general purpose modeling framework. It consists of two phases: engineering analysis and economic analysis. User inputs are stored in a data base and may be retained for future use. Model outputs include a recap of user inputs, calculations for gas production, digester heat requirements, system revenues, yearly cash flow, and a graph of the net present value of the investment. The model is generalized so that non-farm applications may also be analyzed. The economic assessment can be prepared for individuals, corporations, and non-profit organizations. The program will work equally well for various digester designs such as continuously stirred reactors, plug-flow systems, and fluidized-bed columns. The program accepts inputs and displays results in English units.

34428 **(ORNL/TM—7622) Production of ammonia in a packed-bed, anaerobic upflow (ANFLOW) bioreactor.** Hines, D.C.M. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 101p. NTIS, PC A06/MF A01. Order Number DE81030699.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

The objective of this study was to monitor effluent ammonia concentrations and ammonia production rates within the ANFLOW bioreactor as influent soluble chemical oxygen demand (SCOD) concentrations and flow rates were varied. Correlations between influent organic loadings and effluent ammonia concentrations and ammonia formation were sought. Subsequent ammonia removal methods were proposed. A packed-bed, aerobic upflow bioreactor was tested for nitrification of effluent ammonia for the ANFLOW bioreactor. Removal rates of SCOD ranged from 87 to 95% within the ANFLOW bioreactor. The most efficient SCOD removal occurred at the highest organic loading rate (OLR). Profiles of SCOD and volatile acids concentrations showed distinct regions of complex organics breakdown and wastes stabilization. Hydraulic flow within the ANFLOW bioreactor behaved approximately as in a plug-flow reactor. The effluent ammonia concentration appeared to be a function of hydraulic loading rate (HLR). For a given OLR or influent SCOD, effluent ammonia concentrations were less at the higher flow rate. These results suggest that, at the shorter hydraulic residence time (HRT), there was less time for ammonia accumulation and that conversion of organic-nitrogen to ammonia-nitrogen could not be fully completed. However, overall ammonia-nitrogen formulation (in terms of grams produced per day) was found to be a linear function of OLR. The figures presented could be used for predicting ammonia formation for a given OLR or effluent ammonia concentration for a given OLR, HLR, or SCOD. It was demonstrated that the ammonia can be nitrified using a packed-bed aerobic upflow bioreactor with only 5% of the volume of the ANFLOW bioreactor and an HRT of only a few hours. A series of packed-bed bioreactors was recommended for carbon removal-waste stabilization, ammonia removal, and denitrification.

34429 **(PB—81-134793) Energy from biological processes. Volume III. Appendices. Part C: Select conversion technologies and end use.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Sep 1980. 717p. NTIS. Order Number DE81904166.

Portions of document are illegible.

This volume contains reports of research in the following areas: end use of fluids from biomass as energy resources in both transportation and nontransportation sectors; thermochemical conversion of biomass; engineering aspects of thermochemical conversion; and the biological production of gas. Separate abstracts have been prepared for each area for inclusion in the Energy Data Base. (DMC)

**34430** (PB—81-134793, pp vp, Paper 2) **Thermochemical conversion of biomass: the scientific aspects.** Antal, M.J. Jr. Sep 1980. NTIS. Order Number DE81904166.

In Energy from biological processes. Volume III. Appendices. Part C: Select conversion technologies and end use.

The chemistry and physics of biomass pyrolysis and gasification are discussed in this report. A review of fuels science including gaseous fuels, liquid fuels, and solid fuels is presented. The physical and chemical characteristics of biomass feedstocks are described. Generic technologies and economics of thermal conversion processes are evaluated. End uses as well as future projections for synthetic fuels are also discussed. (DMC)

**34431** (PB—81-134793, pp vp, Paper 3) **Assessment on energy from biological processes, Task V. Part I. Engineering aspects of thermochemical conversion. Final report.** Beck, S.R.; Parker, H.W. (Texas Tech Univ., Lubbock). Sep 1980. NTIS. Order Number DE81904166.

In Energy from biological processes. Volume III. Appendices. Part C: Select conversion technologies and end use.

Biomass is considered to include any plant matter, terrestrial or aquatic, and all animal residues. Biomass can be viewed as nature's way of storing solar energy which can be recovered by either direct combustion or conversion to liquids or gases. This report reviews processes which are in use or proposed for energy recovery from biomass at high temperatures. The authors address primarily the engineering aspects of the processes. A separate report is being presented which will discuss the fundamental aspects of thermochemical conversion. Several feedstocks are considered. The processes are discussed by generic type and only a few representative processes are analyzed in detail. These processes are divided into large-scale and small-scale applications. Small-scale processes are defined as those designed to produce energy for an individual, such as a farmer, or a small group of users. Large-scale processes are those that produce energy on an industrial scale for in-house use or sale to a large group (such as a city) of users. The most important aspect of this report is the assessment of future prospects for the processes. The most promising processes in terms of economics and potential for a significant energy contribution are identified. An attempt to determine necessary levels of research development, and demonstration for biomass conversion is also presented.

**34432** (PB—81-134793, pp vp, Paper 4) **Task VI. Biological production of gas.** Abeles, T.; Ellsworth, D.; Genereaux, J. (I.E. Associates, Inc., Minneapolis, MN). Sep 1980. NTIS. Order Number DE81904166.

In Energy from biological processes. Volume III. Appendices. Part C: Select conversion technologies and end use.

The anaerobic process is nominally described as a three phase biological conversion of organic material to gas and a stabilized effluent. The first step, if required, is pretreatment of the feedstock to facilitate digestion. The next two phases are termed acid formation and methane formation. These are characterized by the particular end products produced by sets of anaerobic bacteria during fermentation. The optimization of gas production is predicated upon the ability to provide a maximized environment for the microbial populations. Physico/chemical parameters such as pH, temperature, alkalinity are discussed with some of the substrate requirements touched upon. Also, such engineering factors as retention and time and temperature will affect performance. Basically, the optimized engineering design is predicated upon the choice of the feedstock. The materials which have been considered are summarized along with yield possible and critical evaluations. Animal manures currently are considered to be the best feedstock for farm biogas plants since they provide the highest conversion ratio of the readily available agricultural residues. The choice of feedstocks, including some theoretical thermodynamic calculations of possible yields and energy outputs is given in detail. A description of the Pompano facility for anaerobic digestion of municipal wastes and other operational systems is discussed and summarized. Two types of energy analysis were considered. The first, a theoretical thermodynamic analysis and an engineering analysis. The cogeneration to save energy couples with the economic analysis to indicate that farm cooperatives may become an attractive alternative over single farm systems in many situations. The economics are discussed in fine detail. Prospects for the future are discussed.

**34433** **(SERI/TR—98020-1) Economic and kinetic studies of the biological production of farm energy and chemicals from biomass. Annual progress report, March 1979-August 1980.** Gaddy, J.L. (Arkansas Univ., Fayetteville (USA). Dept. of Chemical Engineering). Aug 1981. Contract AC02-77CH00178. 119p. NTIS, PC A06/MF A01. Order Number DE82000044.

A system has been designed and built to test the technical and economic feasibility of producing farm energy from cellulosic residues. The system has the capacity to produPropinibactriume 1300 CF of biogas and 180 kwh per day, using four parallel batch anaerobic digesters which are agitated mechanically and heated with waste heat from the engine-generator. This system has been satisfactorily operated for a one year period utilizing native grasses as the raw material. Laboratory reactors have been operated to determine the proper inoculation ratio for starting batch cultures with cellulosic raw materials. Procedures for startup and operation of batch digestion systems have been developed and are presented. Energy and economic analyses of the operation of the test unit have been performed. Studies to determine the fertilizer potential of anaerobic digestor sludge (from agricultural residues) have been conducted. Additional studies reported include determinations of the feasibility of separating the stages of anaerobic digestion, the production of acetic and propionic acids by the micro-organism Propionibacterium acidi-propionici, the production of methane from acid hydrolyzates, and the kinetics of the continuos digestion of corn stover.

**34434** **(SERI/TR—98356-1) Biomethanation of biomass pyrolysis gases. Final report.** Tracy, C.A.; Ashare, E. (Dynatech R/D Co., Cambridge, MA (USA)). Aug 1981. Contract AC02-77CH00178. 130p. NTIS, PC A07/MF A01. Order Number DE82000238.

Gasification processes have the potential to produce a synthesis gas (principally $H_2$, $CO_2$, and CO) from biomass. The advantage of such processes is all the organic components of the biomass may be converted to synthesis gas. However, this low Btu value gas is of limited use as a fuel gas. In order to convert the synthesis gas into pipeline quality methane, a methanation process is necessary. Catalytic methanation at high temperature and pressure is one such process. A potentially more economical alternative is the utilization of a biological system to carry out the conversion of biomass pyrolysis gases to methane. It was the object of this study to develop the biological methanation process and to establish conditions for maximum performance.

## 0902 Alcohol Fuels

*REFER ALSO TO CITATION(S) 34248, 34419, 34430, 34431, 34498, 34499, 34504, 34508, 34512, 34520, 34523, 34534, 34665, 34990, 35102, 35105, 35117, 35117, 35123, 35124, 35125, 35126, 35127, 35128, 35132, 35136, 35137, 35138, 35139, 35141, 35144, 35145, 35147, 35152, 35158, 35159, 35160, 35161, 35162, 35163, 35164, 35167, 35168, 35172, 35173, 35174, 35175, 35176, 35177, 35178*

**34435** **(ANL/CNSV—14) Environmental assessment of the use of alcohol fuels in highway vehicles.** Bevilacqua, O.M.; Bernard, M.J. III; Sperling, D.; Rosenberg, S.; Hill, L.J.; Fingleton, D.; D'Eliscu, P.; Gasper, J.R. (Argonne National Lab., IL (USA)). Dec 1980. Contract W-31-109-ENG-38. 307p. NTIS, PC A14/MF A01. Order Number DE82000887.

This environmental assessment examines the impacts of large-scale use of alcohol fuels as petroleum extenders (alcohol/gasoline blends) and petroleum substitutes (neat alcohol fuels) for highway vehicles. Impacts associated with alcohol fuel storage, distribution, and use are assessed under four possible scenarios of alcohol

fuel use during the period 1980 to 2000. Alcohol use is projected to range from 196 million bbl/yr to 620 million bbl/yr by 2000, up from 5 million barrels in 1980. In addition to effects on the physical environment (aquatic and terrestrial ecosystems, air quality, and energy resources), consideration is given to the impacts of alcohol fuel use on such social and economic concerns as health and safety, employment, retail fuel costs, balance of trade, capital investments, and regulatory needs. Although some potentially negative impacts are identified, in general, the assessment finds that the use of alcohol fuels would have a positive or neutral effect on the environment; moreover, the negative impacts could be mitigated through the judicious application of existing regulatory controls and procedural standards.

34436 (ANL/EES-TM—147) **Ethanol production via fungal decomposition and fermentation of biomass, Phase 1. Progress report, FY 1980.** Antonopoulos, A.A.; Wene, E.G. (Argonne National Lab., IL (USA)). Sep 1980. Contract W-31-109-ENG-38. 25p. NTIS, PC A02/MF A01. Order Number DE82000103.

This work was motivated by recorded evidence that Fusarium strains decompose cellulose, hemicelluloses, pectic substances, and lignin, and also ferment both pentoses and hexoses to ethanol. During FY 1980, research efforts in this program's Phase I focused on: (a) collecting and reviewing relevant bibliographic materials for a forthcoming publication; (b) isolating, culturing, and maintaining Fusarium, Trichoderma, and actinomycetous strains for biochemical screening and evaluation; (c) manipulating the genetic constitution of promising Fusarium strains to develop more effective strains for the decomposition and fermentation of biomass; (d) screening for potentially cellulolytic Fusarium and Trichoderma strains; (e) searching for lignolytic and hemicellulolytic Fusarium strains; and (f) screening for effective pentose- and hexose-fermenting Fusarium strains. By September 1980, more than 500 Fusarium strains and about 150 Trichoderma strains had been isolated and screened; all showed cellulolytic activity, with forty-five of the Fusarium strains being exceptionally potent. Several Fusarium strains grown on xylan show a dimorphism (formation of fusoid cells) that may increase their fermenting ability. Several isolated Fusarium strains were active in fermenting pentose and hexose.

34437 (ANL/EES-TM—148) **Ethanol production via fungal decomposition and fermentation of biomass. Phase II. Semiannual progress report, October 1980-March 1981.** Antonopoulos, A.A.; Wene, E.G. (Argonne National Lab., IL (USA)). Mar 1981. Contract W-31-109-ENG-38. 21p. NTIS, PC A02/MF A01. Order Number DE82000104.

A literature review reveals that Fusarium strains decompose cellulose, hemicelluloses, and lignin, as well as ferment five- and six-carbon sugars to ethanol. During the first part of Phase II (first half of FY 1981) in this program, research efforts focused mainly on continuing the: (a) isolating, culturing, and maintaining of Fusarium strains for biochemical evaluation; (b) screening for potentially cellulolytic F. strains; (c) searching for lignolytic and hemicellulolytic F. strains; (d) screening for effective pentose- and hexose-fermenting F. strains; and (e) evaluating various methods and materials for the optimization of certain fermentation parameters. Approximately 200 additional Fusarium isolates were isolated and screened; all showed cellulolytic activity, with 50 showing increased activity. Several isolates that formed fusoid to spheroid spores and cells on xylan media were observed to retain their morphology in cellulose suspensions. All tested isolates were found to ferment glucose to ethanol; some yielded amounts of ethanol approaching those produced by yeast. In screening more than 600 isolates for xylose fermentation, 25 were identified as effective fermenters. Reutilization of inoculum during consecutive fermentations was employed to facilitate higher ethanol yields from xylose. A few Fusarium isolates indicated relatively high ethanol tolerability.

34438 (CONF-801030—(Vol.1), pp 3-7) **Integral approach to power alcohol production.** Faust, U. (Uhde GmbH, Hoechst, Germany); Praeve, P. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The individual process steps for ethanol production as an automotive fuel, from agricultural plantation to the final use, are all well developed. The adaptation of each step to the others and to the existing local production conditions, however, has not been put into practice anywhere, so that existing know how and technology is not used as yet for optimal process design. A model of procedure to this aim is presented and discussed.

34439 (CONF-801030—(Vol.1), pp 9-12) **Low energy consumption of distillation equipment during the production of ethanol fuels.** Katzen, R.; Frank, B.; Giannoni, V.T. (Nordon Industrias Metalurgicas, Sao Paulo, Brazil). 1980. (In Portuguese). NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

34440 (CONF-801030—(Vol.1), pp 13-19) **Solid phase fermentation for intermediate scale ethanol production.** Kirby, K.D.; Mardon, C.J. (Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A solid phase fermentation process is being developed for the production of fuel ethanol from sugar beet and other sugar and starch crops. The advantages of the process are: no need for nutrient addition, as there is sufficient nutrient in the beet; no need for beet sterilization; no need for expensive sugar extraction equipment; lower capital cost compared with the liquid phase fermentation process, e.g., the fixed capital for a 1.5 Ml/yr plant would be about 57% lower than that for a similar liquid fermentation plant; lower production cost compared with the liquid phase process, e.g., the production cost is 25% lower for a 1.5Ml/yr plant; and, less stillage for disposal.

34441 (CONF-801030—(Vol.1), pp 23-24) **EX-FERM process for ethanol production.** Rolz, C.; de Cabrera, S.; Morales, E.; de Arriola, M.C.; de Micheo, F. (Instituto Centroamericano de Investigacion y Tecnologia Industrial, Guatemala). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The EX-FERM process is the concurrent extraction and fermentation of the sucrose in sugar cane to ethanol. This novel solid-liquid mixed phase fermentation system is described, giving details of the experiments at the laboratory level.

34442 (CONF-801030—(Vol.1), pp 33-36) **Use of microwave ovens in the production of industrial ethanol.** Senise, J.T.; Concone, B.R.V.; Moraes, V.L.V.; Doin, P.A.; Medugno, C.C.; Andrade, A.O.M.; Perri, E.B.; Perin, A.H. (Instituto Maua de Tecnologia, Sao Caetano do Sul, Brazil). 1980. (In Portuguese). NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Production of ethanol from starchy materials is now being investigated in Brazil as an alternative source for alcohol production apart from sugar cane. In the present work, with the objective of optimizing the energy balance of the process, substitution of conventional sources of energy by electricity at one stage of the process is sought. Cooking and dextrinization of cassava roots, previously treated by conventional pretreatments, by microwaves heating (at 2450⁻ MHz) has been studied. Results of saccharification and fermentation of the mash thus obtained were used to evaluate the technical feasibility of the process. Specific energy consumption figures (for the cooking and dextrinization stage) of 600 kcal/l of ethanol produced and efficiencies of 90% (in terms of the theoretical maximum yield from the available starch) were easily and consistently obtained.

34443 (CONF-801030—(Vol.1), pp 37-42) **Net energy balance of ethanol production from wood.** Wettstein, P.; De Vos, J. (Inventa AG, Domat/Ems, Switzerland). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The original Inventa process for the production of fuel-grade ethanol from wood was used in a 33000 liter a day plant at Domat/Ems, Switzerland until 1956. Based on this earlier operating experience an updated process package has been developed with much more sophisticated heat integration. A detailed analysis of the internal energy flows of that process will be presented and findings compared to the energy balance of the ideal theoretical model to quantify the gains in efficiency resulting from Inventa's present technology.

34444 (CONF-801030—(Vol.1), pp 45-48) **Improvement of alcohol fermentation.** Hsie, M.C. (Taiwan Sugar Research Inst., China); Su, Y.C. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

For the purpose of improving the efficiency of alcohol fermentation and reducing the cost of alcohol production, the following research were carried out. (1) The effect of cell recycle on the efficiency of alcohol fermentation, (2) the optimal inoculum size for the batch alcohol fermentation, (3) the effect of the batch-fed operation on the efficiency of alcohol fermentation, and (4) the influence of cultivation of seed under aeration and agitation on alcohol fermentation. From the results obtained, with regard to the use of cell recycle, no increase in efficiency of conversion of sugar to alcohol was observed and the time required for a batch of fermentation could be reduced. Moreover, molasses required for the cultivation of seed could be saved since the efficiency of alcohol fermentation kept almost unchanged after nine runs with cell recycle. As to the effect of inoculum size, the range from 5 to 10% v/v was found to be sufficient. In the run with higher inoculum size than 10%, no obvious rise in efficiency could be obtained; however, the fermentation time could be greatly reduced. Inoculum size might be reduced to as small as below 1% v/v when the fermentation was proceeded under shaking at 100 rpm. The batch-fed fermentation trials were carried out with a 14-l fermentor and the yield of alcohol was compared with that of conventional batch process. Two kinds of molasses, one from carbonation plant and the other from defecation plant, were employed as substrates. Fermentation was conducted with a sugar concentration of 17% or 21%. From the results, it was found that the yield obtained was better from the batch-fed process than from the conventional batch process, especially when the fermentation was proceeded under high sugar concentration (21%) with carbonated molasses. The advantage of batch-fed process for alcohol production was thus confirmed by the experiments.

34445 (CONF-801030—(Vol.1), pp 51-55) **Application of low-temperature liquefaction in production of ethanol from starch.** Nielsen, B.H.; Rosendal, P. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology, Sao Paulo, Brazil (5 Oct 1980).

In order to examine the feasibility of liquefaction of starches without heating, some trials were made. As raw material manioc and maize were selected because these starch sources are considered the more important ones when the topic is ethanol as fuel alcohol. The results indicate that it is possible to produce alcohol direct from native starch without heating. It has been known for some years that it is possible to saccharify starch without gelatinization, so we tried to go one step further and mix pure starch, enzymes, and yeast at a temperature of 30°C and found that alcohol was produced. Either very high enzyme dosages or very long fermentation times are needed, and the process works only with pure starch. It is possible that, in some years, alcohol will be produced from starch-containing raw materials without an energy-demanding liquefaction; but till then, an economic process still requires a heating step to gelatinize the starch to make it susceptible to the enzymes and the yeast. The experiments demonstrate, however, that the temperature necessary is considerably lower than previously assumed.

34446 (CONF-801030—(Vol.1), pp 57-61) **Impact of differing raw materials and alternate fermentation methods on process designs for the production of fuel grade ethanol.** Prouty, J.L. (Davy McKee Corp., Chicago, IL). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The production of fuel grade ethanol involves a series of process steps which can be summarized into the following three categories: (1) treatment of the raw material to produce a fermentable carbohydrate and preparation of a suitable fermentation medium, (2) fermentation of the carbohydrate by a living microorganism to produce carbon dioxide and ethanol, and (3) distillation for the recovery, purification and dehydration of fuel grade ethanol. It is the purpose of this paper to demonstrate how the first two categories are dependent on each other and to describe microbial growth along with an evaluation of the alternate fermentation methods for the production of fuel grade ethanol. The design of fuel ethanol plants must integrate the raw material preparation process into the fermentation process, as one is dependent on the other. Continuous and cell recycle fermentation schemes can be used where clear substrate streams of fermentable sugar are used. Substrates with high amounts of insoluble material are only amenable to the batch fermentation process. Fermentor productivity is a function of cell concentration and ethanol inhibition. Continuous fermentation increases fermentor productivity by eliminating fermentor down time and the lag phase of yeast growth . The dilution rate in the continuous process is dependent on the growth rate of the yeast organism and can be predicted from batch culture data.

34447 (CONF-801030—(Vol.1), pp 63-65) **Self-regulating reflux control for ethanol distillation.** Scott, G.K. (SunStor Corp., Orem, UT); Glassett, J.M. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A reflux control method for distillation columns is described which is self-regulating. A very precise temperature control is achieved by using the vaporization temperature of the product to regulate the reflux heat exchange rate. Instead of the conventional method of returning product to the top of the distillation column for temperature control, a heat exchanger is provided in the top of the column which partially condenses the rising vapors which return to the column as reflux. This reflux heat exchanger is cooled by revaporizing the product which has been condensed in an overhead condenser and returned to the outside shell of the reflux heat exchanger by gravity. By this means, the top of the distillation column is always maintained at exactly the vaporization temperature of the product. The condensers may be cooled by the incoming feed. Additional reflux may be provided by a feed-cooled heat exchanger below the product cooled heat exchanger. This method of reflux control eliminates the need for reflux drums, pumps, and controllers. Potential exists for lowering the cost of distillation columns, especially for smaller units used in ethanol fuel production in remote areas or developing countries. The above mentioned self-regulating technique has been tested in laboratory scale equipment and has been found to be very precise in its control. Laboratory models distilling ethanol/water mixtures have consistently produced a 95% ethanol product even when the feed contained only 3% ethanol.

34448 (CONF-801030—(Vol.1), pp 67-70) **Biological control of alcohol fermentation at the industrial level.** Serra, G.E. (Universidade Estadual, Paulista, Brazil); Cereda, M.P.; Meneguim, M.A.; Pinho, S.Z.; Marino, E.A.; Ferreira, L.J.; Bethiol, A.E. 1980. (In Portuguese). NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

**34449** (CONF-801030—(Vol.1), pp 71-75) **Continuous cooking of starch slurries for the production of ethanol.** da Silva, G.H.; de Abreu Coutinho, P.H. (Petroleo Brasileiro S.A., Rio de Janeiro, Brazil). 1980. (In Portuguese). NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

An experimental study of the operational conditions for starch slurry was made with the objective of improving the energetic yield in the process of ethanol production from amilaceous feedstock. It was demonstrated that the cassava starch processing, with a non-thermostable alpha-amylase addition, in continuous jet cooker operating around 80°C will lead to the production of a cooking slurry adequate for enzymatic hydrolysis and alcoholic fermentation.

**34450** (CONF-801030—(Vol.1), pp 95-100) **Economics of fuel ethanol from beet.** Earl, W.B. (Univ. of Canterbury, Christchurch, New Zealand); Brown, W.A.N. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The economics and energetics of processing fuel ethanol from fodder beets are examined. Three variants of by-product disposal are costed, including methane digestion, feedlotting of pressed pulp, and manufacture of dried pelleted pulp. This pellet option proves the most attractive option, generating fuel ethanol at a price close to imported refined motor spirit.

**34451** (CONF-801030—(Vol.1), pp 101-105) **Analyzing the feasibility of increasing output in a distillery which uses sugar cane in the production of ethanol.** Doin, P.A.; Bastos Neto, A.O.; Pinto, A.G.; Concone, B.R.V. (Instituto Maua de Tecnologia, Sao Caetano do Sul, Brazil). 1980. (In Portuguese). NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

**34452** (CONF-801030—(Vol.1), pp 107-111) **Economics of ethanol from waste fruit using geothermal process heat and wood for fuel.** Hodam, R.H.; Lesser, M.C. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The cost of anhydrous ethanol for fuel is dramatically affected by the cost of feedstock and fuel. In areas where waste fruit, waste wood and geothermal steam are available, the operating cost may be lowered significantly especially when they are combined. As a result, the economic viability of small scale alcohol production is very site specific, but where the right conditions exist plant profitability can be very high. Price scenarios for corn, almond hulls, and fruit culls as raw materials for ethanol production are included. The economics of alternative boiler types and fuels for a 4.5 million gallon plant are examined. Estimates are presented for capital and operating costs for an ethanol plant using geothermal energy supplies. (DMC)

**34453** (CONF-801030—(Vol.1), pp 113-117) **Energy consumption in the distillation of fuel alcohol.** Leppanen, O.; Denslow, J.; Ronkainen, P. (State Alcohol Monopoly (Alko), Helsinki, Finland). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

It is well known that the main energy consumption in the preparation of fermentation alcohol occurs during the stripping of the alcohol from the fermentation mash. The energy required for this operation falls rapidly as the alcohol content of the feed mash rises up to about 10% and then falls more slowly as the alcohol level rises further. Mash and rectifying columns are commonly run at excessive boil up rates with the bottoms containing unnecessarily low concentrations of alcohol. This can be avoided by continuously monitoring the alcohol content of the bottoms. Maintaining a minimum pressure drop in the mash column by minimizing fouling is another important way of reducing energy consumption. In conventional systems a large part of the total energy goes into the cooling water of the condensers producing the reflux, and at best the steam consumption is just less than 4 kg/litre absolute ethanol. This can be reduced to less than 3 kg/litre absolute ethanol, if columns working at different pressures are connected in series so that vapor from one column can perform boil up in another. Another operation, in addition to distillation, that is a major consumer of energy is the treatment of stillage, which can be tackled in various ways to reduce energy costs. When the stillage is treated by evaporation and burning (molasses) or by drying (grain), the economics of the treatment can be substantially improved by re-using stillage water to prepare more mash so that the solids content of the stillage rises and less water has to be evaporated away. Re-using stillage water in this way means that about 1.5 kg more steam/litre absolute ethanol can be obtained by burning molasses stillage concentrate than is required in its evaporation, and the steam consumption of evaporation and drying of grain stillage is reduced to 1.5 kg/litre ethanol.

**34454** (CONF-801030—(Vol.1), pp 119-122) **Development of technology for improvement in energy balance in production of ethyl alcohol from sugarcane molasses.** Malik, V.K. (Daurala Chemical Industries, India). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The development of a new technology to improve energy balance in the production of ethanol from sugar cane molasses is outlined in this paper. This technology includes: the recycling of yeast; the anaerobic digestion of spent wash; the use of the methane produced for process and plant heat; and the use of digested effluent for irrigation and nutrient recycling in soils. (DMC)

**34455** (CONF-801030—(Vol.1), pp 139-141) **Industrial efficiency of alcohol fermentation: a comparative study.** Ferrari, S.E.; Lopes, J.J.C.; Leme, J.R.A.; de Oliveira, E.R. (PLANALSUCAR, Piracicaba, Brazil). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A preliminary trial was carried out under laboratory conditions, comparing the industrial efficiency of different yeasts presently used in the alcohol production in Brazil. The following yeasts were tested concerning production and time of fermentation: pressed, wild and selected. The selected yeast IZ-1904 showed the best performance according to the parameters considered, followed by the commercial yeasts (Fleischmann and Itaiquara) and finally by the wild yeasts.

**34456** (CONF-801030—(Vol.1), pp 143-150) **Improving the scenario for ethanol production: the new ethanol producers.** Vergara, W. (Centro de Tecnologia Promon, Rio de Janeiro, Brazil). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

This paper discusses the opportunities for utilization of non-traditional microorganisms in large scale ethanol production. Bacteria in particular offer interesting chances for medium term competitive substitution of Saccharomyces spp as main ethanol converter. Main reasons for attractiveness lay among others on the following facts: strict anaerobic character (which dispenses air supply and filtration equipment); potentially higher yields; reduced doubling times; improved susceptibility for genetic manipulation and handling. One such bacterium is Zimomonas subtilis. If applicable, available laboratory and pilot plant data forecast a 21% reduction in continuous fermentation costs (excluding raw material costs) for current conditions in Brazil, when Z. mobilis is used instead of S. cerevisiae. Likewise a 30% decrease in fixed investment is associated to a continuous fermentation unit at 150 $m^3$/day capacity operating with Z. mobilis. In the long run cellulolytic bacteria may have the key for economical conversion of cellulose to ethanol but con-

siderable effort remains in the way to a competitive cellulolytic microorganism. In particular, main current limitations of C. thermocellum include its low ethanol tolerance and the important quantities of byproducts generated together with alcohol.

34457 (CONF-801030—(Vol.1), pp 153-156) **Description of a full scale ethanol production plant for direct processing of sugar cane and sweet sorghum according to a thermal treatment process - technical and economical aspects.** Brueschke, H.; Tusel, G.F.; Ballweg, A.H. (Incon Anlagentechnik GmbH, Homburg, Germany). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Today the technology in use for the production of fuel grade ethanol from sugar cane, does mainly follow the routes which had been developed for the production of crystal sugar and potable alcohol from this raw material. In order to decrease production costs and necessary investment, and make use of a broader variety of raw materials, a process has been developed, which avoids the use of roller mills for juice extraction, but liberates the fermentable sugar by the influence of elevated temperatures and pressures. The sugar cane is only coarsely chopped for better handling, and fed into a reaction vessel, where it is treated by direct injection of low pressure steam. The combined influences of elevated temperature and pressure rapidly disintegrate the sugar containing cells, thus allowing to collect and separate the sugar containing solution from the unsoluble residues by a simple washing process. Heat treatment, as well as washing, are done in a continuous process. After cooling, the solution thus produced can be fermented without any further treatment and purification. A broad variety of raw materials, including sugar cane of different degrees of ripeness, sugar and fiber content, as well as damaged cane, can equally be processed. It has been shown that sweet sorghum can be processed, alternatively to, or simultaneously with sugar cane. In this report, a technical description of a full scale autonomous ethanol plant using this process is given, together with its economics. It can be shown that especially for small and medium size plants in the range between 30,000 and 100,000 l/d, this process is superior in its economics to the conventional process.

34458 (CONF-801030—(Vol.1), pp 157-164) **Development of community-sized fuel alcohol production units in the southeastern United States.** Herz, W.J. (Univ. of Alabama, Huntsville); Brett, C.E.; Snyder, C.A. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A community-sized fuel alcohol plant producing from 150,000 to 2 million gallons per year is described in this paper. Improvement of economics, environmental aspects, and energy conservation in the production of ethanol from grain is discussed. Corn and sorghum are the materials of choice in the southeast. A fuel alcohol prototype production unit was designed and its operation is described. Base-line data is being collected in order to have complete energy and material balances for all options of operation on the prototype. The Alcohol Fuels Program in the southeastern United States is still in the developmental stage. While over 1000 licenses have been issued for operating alcohol distillation units, we could find no operating units other than our prototype at Dixie Steel. Major road-blocks mentioned in our state-by-state survey were lack of competent engineering and construction capacity at a reasonable cost, financing, and the slow response of government programs aimed at supporting the alcohol fuels program. To this list add raw material cost. Plant sites in the Southeast cannot draw heavily on local corn and milo supplies. This adds a large burden in the form of added cost per unit of raw material and higher working capital due to larger inventory requirements.

34459 (CONF-801030—(Vol.1), pp 179-184) **I.F.P. way to produce $C_1$ - $C_5$ alcohols for use as a gasoline blending component.** Sugier, A.; Arlie, J.P.; Freund, E. (Institut Francais du Petrole, Rueil-Malmaison, France). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

I.F.P. has studied an integrated process to produce a mixture of alcohols which can be used as a motor fuel blending component. This process is characterized by the coupling of two catalytic reaction zones in order to produce from synthesis gas a mixture of 15 to 20 wt % of $C_2^+$ alcohols and 80 to 85% of methanol. A preliminary economic evaluation of the new I.F.P. process shows that the product value is approximately 15% more than for methanol.

34460 (CONF-801030—(Vol.1), pp 185-189) **Small scale production of ethyl alcohol.** Villen, R.A. (Instituto de Pesquisas Tecnologicas, Sao Paulo, Brazil). 1980. (In Portuguese). NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

34461 (CONF-801030—(Vol.1), pp 199-204) **Electro chemical route wood to syngas.** Oliveira, E.S. (Companhia Energetica, Sao Paulo, Brazil). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Although Brazil has had great success in using ethanol to extend petroleum supplies, other sources for fuel are being investigated. The production of methanol from wood via syngas is one such method. Eucalyptus trees grow well in the Brazilian hinterland deemed unsuitable for other crops. With inducement of fiscal incentives alone, the country is being reforested at the rate of 300,000 ha a year without a guaranteed market. The government plans to encourage the gasification of this wood for the production of liquid fuels. The CESP electrochemical gasifier is described. The advantages for using this type of gasifier are outlined. The use of this wood for power generation is also being investigated. (DMC)

34462 (CONF-801030—(Vol.1), pp 207-214) **Use of gasoline-alcohol blends in a spark ignition engine with different levels of simulated turbocharging.** Chelliah, V.S.; Crookes, R.J.; Janota, M.S. (Univ. of London, England). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A study of the use of a range of blends of unleaded gasoline with methanol and isobutanol in a single cylinder variable compression ratio Ricardo E6 research engine has been made. The investigation covered naturally aspirated and simulated turbocharged conditions with two levels of boost pressure ratio and at two engine speeds. The results are presented for optimum conditions of ignition timing, at highest useful compression ratio and at fully opened throttle setting as functions of engine speed, boost pressure ratio and equivalence ratio in the form of lines of constant parameter values on ternary constituent graphs. In general, engine performance parameters and exhaust emission levels obtained with methanol as fuel differed more markedly from the values obtained with unleaded gasoline than did those with isobutanol. Under conditions of moderate boost pressure ratios (at either engine speed) better performance and emission characteristics were obtained with the higher alcohol content blends than with the unleaded gasoline operating under naturally aspirated conditions.

34463 (CONF-801030—(Vol.1), pp 289-291) **Demonstration of dissociated methanol as an automotive fuel: system design.** Finegold, J.G.; Karpuk, M.E.; McKinnon, J.T. (Solar Energy Research Inst., Golden, CO). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The objective of this work currently underway at SERI is to demonstrate the feasibility of burning dissociated methanol in an automobile. The motivation for doing this is to obtain higher vehicle efficiency than can be obtained from cars burning pure alcohol or alcohol blends. At the time of this writing, the work is progressing from the component test and final system design phase to the system assembly and testing phase. This paper describes the system

design to accomplish the objective. A 1980 Chevrolet Citation has been selected for this demonstration.

34464 (CONF-801030—(Vol.1), pp 293-298) **Study of the vaporization and combustion properties of distillate fuel droplets containing methanol or ethanol.** Lasheras, J.C.; Kennedy, I.M.; Dryer, F.L. (Princeton Univ., NJ). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

In order to investigate the possible disruptive behavior of solutions and emulsions of absolute methanol or ethanol in distillate fuel oils, systematic experimental studies of the vaporization and combustion of isolated, monodispersed free droplets of these systems have been conducted. Experiments were performed by injecting the droplets into a hot convective, atmospheric pressure environment, parallel to the direction of the gas flow. The convective flow was established by the post-combustion gases of a premixed flat-flame burner. Control of the fuel to oxygen ratio in the burner provided an oxidizing or non-oxidizing gas to perform the combustion and vaporization studies respectively. For the ethanol in No. 2 fuel oil solutions, it was confirmed that disruptive burning results from the homogeneous bubble nucleation within the superheated interior of the droplet, and that there is a maximum and minimum ethanol concentration for which disruptive burning occurs viz., 5% and 90% by volume. In addition, the effect of alcohol concentration on the diameter decrease from the point of ignition to the point of disruption was studied. The results show an optimal ethanol concentration range within 15% and 55% by volume, for which the disruption occurred before consumption of 40% of the initial volume of the solution droplet. Experiments on burning droplets of emulsions of methanol-in-No. 2 fuel oil were also performed. The results show that as little as 5% of methanol by volume will produce disruptive burning. Finally, the effect of the environmental oxygen concentration was studied for these solutions and emulsions. No significant influence on the relative diameter decrease between ignition and disruption was apparent.

34465 (CONF-801030—(Vol.1), pp 313-318) **Influence of oxygenates on the road ratings of typical gasolines.** Marhold, A. (OEMV Test Lab., Vienna, Austria); Tranie, L. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A study of the influence of oxygenates in typical base fuels on the octane requirements of European cars has been made. Ethanol, methanol, TBA and MTBE have been selected as alternative components in percentages of 10% vol. For MTBE 15% vol. was used. As base fuels a high-reformate type and a high-olefin type were defined. Both series were leaded to realistic European lead levels. In comparison to the knock behaviour of the base fuels the ethanol- and methanol-blends showed depreciations under both operating conditions tested, TBA has a very small effect on the road ratings, MTBE shows significant appreciations.

34466 (CONF-801030—(Vol.1), pp 331-335) **Water tolerability of ethanol-gasoline blends.** Terzoni, G.; Pea, R.; Ancillotti, F. (Association for Scientific Research of ENI Group Companies, Milanese, Italy). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The effect of the presence of water in the blends of ethanol and hydrocarbons has been examined at different temperatures ranging from 20°C down to -18°C. The behaviour of the system ethanol-gasoline-water has been compared with the methanol-gasoline-water system investigated previously. The solubilizing efficiency of the isobutanol has been evaluated. The use of aqueous ethanol has been envisaged.

34467 (CONF-801030—(Vol.1), pp 353-356) **Fuel vaporization for fast cold starting of ethanol fueled vehicles.** Harrington, J.A.; Roby, R.J.; Cavolowsky, J.A.; Pinto, F.B.P. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A vaporizer concept to facilitate cold starting of ethanol fueled engines is described and test results obtained during development are presented. Vehicle cold starts at temperatures as low as -10°C with 100% fuel grade ethanol have been achieved with research level hardware. At this temperature, a smooth idle was repeatedly established within one minute after energizing the vaporizer.

34468 **(DOE/PETC/TR—81/3) Synthesis gas conversion to liquid fuels using promoted fused-iron catalysts.** Diffenbach, R.A.; Schehl, R.R.; Fauth, D.J. (USDOE Pittsburgh Energy Technology Center, PA). Sep 1981. 67p. NTIS, PC A04/MF A01. Order Number DE81030857.

This study was carried out with the objective of preparing more active and stable nitrided iron catalysts for the conversion of synthesis gas to a product with a high alcohol content that could be used directly as an automotive fuel or converted to a gasoline-like product over a shape selective zeolite in a dual reactor unit. The rationale is given for the preparation of a molybdenum-promoted nitrided fused iron catalyst. Catalyst characterization yielded equivocal results as to whether a mixed Fe-Mo nitride was formed. Regardless of the nature of the Mo-containing species, these catalysts were significantly more active than unpromoted nitrided fused iron catalyst. Characterization of fused iron catalysts using thermogravimetric analysis indicated the rates of reduction, carburization, and nitriding were strongly dependent on reaction temperature and particle size as well as the nature of the promoter. X-ray diffraction measurements indicated the metal crystallite size of the reduced catalysts was strongly dependent on reduction temperature. A microreactor unit capable of on-line gas chromatographic analysis was constructed for the screening of a variety of carbided iron catalysts. The carbon number distribution obtained using a carbided fused iron catalyst was found to correlate with the Anderson-Schluz-Flory equation.

34469 **(DOE/RA/50331—T1(Vol.1)) AGRI Grain Power ethanol-for-fuel project feasibility-study report. Volume I. Project conceptual design.** (AGRI Grain Power, Des Moines, IA (USA); Boeing Engineering and Construction Co., Seattle, WA (USA)). Apr 1981. Contract FG07-80RA50331. 86p. NTIS, PC A05/MF A01. Order Number DE82000474.

The AGRI GRAIN POWER (AGP) Project, hereafter referred to as the Project, was formed to evaluate the commercial viability and assess the desireability of implementing a large grain based grass-roots anhydrous ethanol fuel project to be sited near Des Moines, Iowa. This report presents the results of a Project feasibility evaluation. The Project concept is based on involving a very strong managerial, financial and technical joint venture that is extremely expert in all facets of planning and implementing a large ethanol project; on locating the ethanol project at a highly desireable site; on utilizing a proven ethanol process; and on developing a Project that is well suited to market requirements, resource availability and competitive factors. The Project conceptual design is presented in this volume.

34470 **(DOE/RA/50331—T1(Vol.2)) AGRI Grain Power ethanol-for-fuel project feasibility-study report. Volume II. Project marketing/economic/financial/ & organization.** (AGRI Grain Power, Des Moines, IA (USA); Boeing Engineering and Construction Co., Seattle, WA (USA)). Apr 1981. Contract FG07-80RA50331. 146p. NTIS, PC A07/MF A01. Order Number DE82000472.

The AGRI GRAIN POWER (AGP) project, hereafter referred to as the Project, was formed to evaluate the commercial viability and assess the desireability of implementing a large grain based grass-roots anhydrous ethanol fuel project to be sited near Des Moines, Iowa. This report presents the results of a Project feasibility evaluation. The Project concept is based on involving a very strong managerial, financial and technical joint venture that is extremely expert in all facets of planning and implementing a large ethanol project; on locating the ethanol project at a highly desireable site; on utilizing a proven ethanol process; and on developing a Project that is well suited to market requirements, resource avail-

ability and competitive factors. The results of marketing, economic, and financial studies are reported in this volume.

34471 **(DOE/RA/50331—T1(Vol.3)) AGRI Grain Power ethanol-for-fuel project feasibility-study report. Volume III. Project environmental/health/safety/ & socioeconomic.** (AGRI Grain Power, Des Moines, IA (USA); Boeing Engineering and Construction Co., Seattle, WA (USA)). Apr 1981. Contract FG07-80RA50331. 128p. NTIS, PC A07/MF A01. Order Number DE82000473.

The AGRI GRAIN POWER (AGP) project, hereafter referred to as the Project, was formed to evaluate the commercial viability and assess the desireability of implementing a large grain based grass-roots anhydrous ethanol fuel project to be sited near Des Moines, Iowa. This report presents the results of a Project feasibility evaluation. The Project concept is based on involving a very strong managerial, financial and technical joint venture that is extremely expert in all facets of planning and implementing a large ethanol project; on locating the ethanol project at a highly desireable site; on utilizing a proven ethanol process; and on developing a Project that is well suited to market requirements, resource availability and competitive factors. This volume contains the results of the environmental, health, safety, and socio-economic studies.

34472 **(DOE/RA/50357—T1) Feasibility study for an alcohol-fuels plant for Buffalo, New York.** (ANDCO Environmental Processes, Inc., Buffalo, NY (USA)). Nov 1980. Contract FG07-80RA50357. 369p. NTIS, PC A16/MF A01. Order Number DE82000032.

A Feasibility Study has been conducted of a 15,000,000 gal per y anhydrous ethanol plant to be located in the Buffalo area. The Feasibility Study has investigated all major aspects of the construction and operation of the plant. The following has been concluded: (1) the volatile energy situation presents too much of a risk for bankers and investors unless the Department of Energy guarantees that they will purchase any alcohol not sold on the open market at a guaranteed price formula; (2) the complete plant design has been prepared and it appears that there is very little technological risk in the process; (3) a suitable plant site is available with all necessary utilities and the plant equipment has been laid out for this site; (4) the plant easily complies with environmental, health, safety and socioeconomic requirements; (5) raw materials consisting of corn and coal are readily available in adequate quantity and at reasonable prices in the Buffalo area; (6) the distillers dried grains and the carbon dioxide can both be sold in their entirety at reasonable prices; (7) capital cost and operating cost are such that the alcohol plant makes an attractive investment with reasonable payout and profit potential; (8) the Financial community has made it exceedingly clear that no loan is available nor is equity capital available unless an 81% of total plant investment loan guarantee is provided by the Department of Energy and further that a product purchase and price guarantee agreement must be supplied by the Department of Energy for any alcohol produced not sold through the local market; and (9) it is recommended that the Department of Energy extend the required loan guarantee and product purchase and price guarantees so that the plant can be put into operation in early 1982.

34473 **(DOE/RA/50365—T1(Vol.1)) Assessment of the economic, technical, and environmental feasibility of developing, constructing, and operating a 25-million-gallon-per-year grain-ethanol-production facility. Volume I. Executive summary.** (Fulton Energy Corp., Tulsa, OK (USA)). May 1981. Contract FG07-80RA50365. 47p. NTIS, PC A03/MF A01. Order Number DE82000294.

The purpose of this study is to determine the economic, technical, and environmental feasibility of developing, constructing and operating a 25 million-gallon per year ethanol facility in northeastern Oklahoma. This project is reported in 4 volumes. This volume contains the executive summary. When this project was first conceived in late 1979, the key criterion seen for project success for an ethanol plant was the selection of a site that can provide (1) necessary grain, energy, and labor resources; (2) flexible transportation methods and alternatives for receiving and shipping; (3) nearby markets for products and by-products; (4) an existing environmental quality able to withstand the minor impacts of the process; and (5) a receptive and growing business and community environment. Having completed more than 17 months of research, including 7 1/2 months on this study, Fulton Energy Corporation concludes that the proposed site not only meets, but exceeds these criteria. The study has also demonstrated the ability to produce a high quality product at a reasonable and competitive price with or without federal assistance or state assistance in the form of tax exemptions. The study has shown that coal burning technologies are efficient, whether conventional burning methods or impressive new and innovative burning methods such as fluidized-bed combustion are used. This report demonstrates that both are feasible in the specific region although the conventional technologies appear to be easier to finance. All resources for the process are available nearby. The grains required come from carryover reserves, thus not impacting the food supply and the residual by-products are in high demand.

34474 **(DOE/RA/50365—T1(Vol.2)) Assessment of the economic, technical, and environmenthel feasibility of developing, constructing, and operating a 25-million-gallon-per-year grain-ethanol-production facility. Volume II. Technical analysis.** (Fulton Energy Corp., Tulsa, OK (USA)). May 1981. Contract FG07-80RA50365. 178p. NTIS, PC A09/MF A01. Order Number DE82000479.

The purpose of this study is to determine the economic, technical, and environmental feasibility of developing, constructing and operating a 25 million-gallon per year ethanol facility in northeastern Oklahoma. This volume contains the technical analysis portion of this study. The key criterion seen for project success for an ethanol plant was the selection of a site that can provide (1) necessary grain, energy, and labor resources; (2) flexible transportation methods and alternatives for receiving and shipping; (3) nearby markets for products and by-products; (4) an existing environmental quality able to withstand the minor impacts of the process; and (5) a receptive and growing business and community environment. Having completed more than 17 months of research, including 7 1/2 months on this study, Fulton Energy Corporation concludes that the proposed site not only meets, but exceeds these criteria. The study has also demonstrated the ability to produce a high quality product at a reasonable and competitive price with or without federal assistance or state asistance in the form of tax exemptions. The study has shown that coal burning technologies are efficient, whether conventional burning methods or impressive new and innovative burning methods such as fluidized-bed combustion are used. This report demonstrates that both are feasible in the specific region although the conventional technologies appear to be easier to finance. All resources for the process are available nearby. The grains required come from carryover reserves, thus not impacting the food supply and the residual by-products are in high demand.

34475 **(DOE/RA/50365—T1(Vol.3)) Assessment of the economic, technical, and environmental feasibility of developing, constructing, and operating a 25-million-gallon-per-year grain-ethanol-production facility. Volume III. Procurement analysis, marketing analysis, and environmental and regulatory analysis.** (Fulton Energy Corp., Tulsa, OK (USA)). May 1981. Contract FG07-80RA50365. 260p. NTIS, PC A12/MF A01. Order Number DE82000478.

The purpose of this study is to determine the economic, technical, and environmental feasibility of developing, constructing and operating a 25 million-gallon per year ethanol facility in northeastern Oklahoma. This volume contains the resource procurement analysis, the marketing analysis, and the environmental, health, safety and socio-economic analyses. The key criterion seen for project success for an ethanol plant was the selection of a site that can provide (1) necessary grain, energy, and labor resources; (2) flexible transportation methods and alternatives for receiving and shipping; (3) nearby markets for products and by-products; (4) an existing environmental quality able to withstand the minor impacts of the process; and (5) a receptive and growing business and community environment. Having completed more than 17 months of research, including 7 1/2 months on this study, Fulton Energy Corporation concludes that the proposed site not only meets, but exceeds these criteria. The study has also demonstrated the ability to produce a high quality product at a reasonable and competitive price with or without federal assistance or state assistance in the form of tax exemptions. All resources for the process are available nearby. The grains required come from carryover reserves, thus not impacting

the food supply and the residual by-products are in high demand. The study has shown that the proposed plant enjoys the integrated assets of site, resources, market, efficient technologies, effective management, and environmental safety.

34476 **(DOE/RA/50365—T1(Vol.4)) Assessment of the economic, technical, and environmental feasibility of developing, constructing, and operating a 25-million-gallon-per-year grain-ethanol-production facility. Volume IV. Economic and financial analysis, management analysis.** (Fulton Energy Corp., Tulsa, OK (USA)). May 1981. Contract FG07-80RA50365. 286p. NTIS, PC A13/MF A01. Order Number DE82000477.

The purpose of this study is to determine the economic, technical, and environmental feasibility of developing, constructing and operating a 25 million-gallon per year ethanol facility in northeastern Oklahoma. This volume contains economic and financial analysis portion of the investigation. The key criterion seen for project success for an ethanol plant was the selection of a site that can provide (1) necessary grain, energy, and labor resources; (2) flexible transportation methods and alternatives for receiving and shipping; (3) nearby markets for products and by-products; (4) an existing environmental quality able to withstand the minor impacts of the process; and (5) a receptive and growing business and community environment. Having completed more than 17 months of research, including 7 1/2 months on this study, Fulton Energy Corporation concludes that the proposed site not only meets, but exceeds these criteria. The study has also demonstrated the ability to produce a high quality product at a reasonable and competitive price with or without federal assistance or state assistance in the form of tax exemptions. All resources for the process are available nearby. The grains required come from carryover reserves, thus not impacting the food supply and the residual by-products are in high demand. The study has shown that the proposed plant enjoys the integrated assets of site, resources, market, efficient technologies, effective management, and environmental safety. Some permitting delays may be suffered but the overwhelmingly positive projections of this study are offsetting.

34477 **(DOE/RA/50391—T1) Technical and economic feasibility study for a 1,500,000 gallon per year anhydrous ethanol manufacturing plant.** (Dvorak Farms, Inc., Whitelaw, WI (USA); Foth and Van Dyke and Associates, Inc., Green Bay, WI (USA)). Mar 1981. Contract FG07-80RA50391. 170p. NTIS, PC A08/MF A01. Order Number DE82000286.

The objective of this study was to determine whether the most appropriate available technology; present and foreseeable resource, market, finance, and economic conditions in the northeastern Wisconsin area may be combined under the proposed management structure to produce ethanol from biomass with favorable economic and energy related results. The method by which this study was completed was to conduct and document a professional review of each of the above mentioned conditions and factors. Each factor was analyzed at a level of detail sufficient enough to allow a decision to be made relative to eventual plant construction. The original intent of the study was to assess the construction and operation of a plant producing between 1,000,000 and 3,000,000 gallons of ethanol per year. Based on an initial assessment of feedstock availability and market and capital requirements, the plant size to be used in this feasibility study was set at 1.5 million gallons per year. One of the first steps in the study was to complete an assessment of the amount of waste biomass feedstock available in the study area. Based on this assessment it was determined that approximately 45,000 tons of waste biomass would be avalable to the plant at the cost of transportation. Subsequent laboratory analyses indicated, though, that the expected ethanol yield from this waste resource would be approximately five gallons per ton or 225,000 gallons per year, which is about 15% of the total annual capacity of the proposed plant. Therefore it was necessary to direct the feasibility study toward a basic plant using corn as a primary feedstock, and waste biomass as a secondary feedstock.

34478 **(K/SUB—80-7994/1) Conversion of ORNL waste paper to sugar using acid hydrolysis.** Clausen, E.C.; Shah, A.H.; Saggurti, P.R.; Teichert, W.P.; Harrison, M.E. (Oak Ridge Gaseous Diffusion Plant, TN (USA); Tennessee Technological Univ., Cookeville (USA). Dept. of Chemical Engineering). 1981. Contract W-7405-ENG-26. 34p. (CONF-811108—5). NTIS, PC A03/MF A01. Order Number DE82000462.

From Annual meeting of the Institute of Chemical Engineers; New Orleans, LA, USA (8 Nov 1981).

The Oak Ridge National Laboratory generates large quantities of waste paper that is presently being landfilled. Three processes were investigated in the laboratory for acid hydrolyzing this waste paper to glucose which may be later fermented to ethanol for fuel. Laboratory yields and operating conditions for a high temperature dilute acid process, a concentrated acid process and a process which utilizes waste acid are presented.

34479 (LBL—11983, pp 3.7-3.10) **Enzymatic conversion of wood and agricultural residues to sugars.** Wilke, C.R.; Blanch, H.W.; Tangnu, K.; Wiley, D.; Long, B.; Rosenberg, S.; Riba, J.P.; Sindalar, L. Mar 1981. NTIS, PC A03/MF A01. Order Number DE81030532.

In Chemical process research and development program, FY 1980.

This research effort encompasses three areas: cellulase production and kinetics, hemicellulose utilization, and organism development. The work's overall goal is the hydrolysis of cellulose and hemicellulose and the fermentation of the resulting sugars to ethanol and other useful neutral products. In this process, cellulose is hydrolyzed using cellulase enzymes produced by the mold Trichoderma ressei. Two of the project aims are the optimization of enzyme production and purification of components of the cellulase complex. By knowing which member or members of the complex are restricting overall conversion, supplementation schemes can be devised. The bacterium Bacillus macerans, which ferments xylose to ethanol and acetone, is being studied in order to maximize the production of these volatile neutral products and to minimize the production of unwanted products, mainly acetic acid. Finally, new microorganisms are being developed for the direct fermentation of cellulose to ethanol without the preliminary separate enzymatic hydrolysis step.

34480 (LBL—11983, pp 3.10-3.13) **Ethanol production and recovery from biomass sugars.** Wilke, C.R.; Blanch, H.W.; Maiorella, B.; Murphy, K.; Vickroy, B.; Wong, H. Mar 1981. NTIS, PC A03/MF A01. Order Number DE81030532.

In Chemical process research and development program, FY 1980.

The goal of this research is to improve ethanol production and recovery from biomass. Research toward this objective is proceeding in four separate but interrelated projects. In the Flash Fermentation for Rapid Ethanol Production project, a process for continuous production and purification of ethanol from fermentation is being tested on a pilot-plant scale. The Alternative Ethanol Recovery work is developing other techniques for ethanol recovery which will consume less energy than traditional distillation. In the project on Novel Fermentor Development, the use of a hollow-fiber fermentor to achieve higher productivities than those of conventional fermentors is being investigated. The remaining project, Nutritional Requirements for Yeast Fermentation, is aimed at precise identification of the metabolic needs of the ethanol-producing yeast to allow specification of medium components for maximum ethanol productivity at minimum cost.

34481 **Effects of metal-support interactions on the synthesis of methanol over palladium.** Ryndin, Yu.A. (Lawrence Berkeley Lab., CA); Hicks, R.F.; Bell, A.T.; Ermakov, Yu.I. Contract W-7405-ENG-48. *Journal of Catalysis ;* **70**: No. 2, 287-297(Aug 1981).

The synthesis of methanol and other products from CO and $H_2$ was studied over Pd catalysts prepared by adsorption of Pd($\pi$-$C_3H_5)_2$ on MgO, ZnO, $La_2O_3$, $\gamma$-$Al_2O_3$, $SiO_2$, $TiO_2$, and $ZrO_2$ as well as over a $SiO_2$-supported Pd catalyst prepared from $PdCl_2$ and Pd black. Both the activity and selectivity of Pd were affected

strongly by the nature of the support and the composition of the Pd precursor. The specific activity for methanol synthesis decreased in the order $Pd/La_2O_3$ much greather than $Pd/SiO_2$ [derived from $PdCl_2$] > $Pd/ZrO_2$ > Pd/ZnO ≅ Pd/MgO > $PdTiO_2$ > $Pd/Al_2O_3$ ≅ $Pd/SiO_2$ [derived from $Pd(\pi\text{-}C_3H_5)_2$] much greater than Pd black while the specific activity for hydrocarbon synthesis decreased in the order $Pd/TiO_2$ > $Pd/ZrO_2$ > $Pd/La_2O_3$ ≧ $Pd/Al_2O_3$ ~ = $Pd/SiO_2$ [derived from $PdCl_2$] ≧ $Pd/SiO_2$ [derived from Pd $(\pi\text{-}C_3H_5)_2$] ~ = Pd black much greater than Pd/MgO much greater than Pd/ZnO. Dimethyl ether production was observed over four of the catalysts and the activity for formation of this product decreased in the order $Pd/Al_2O_3$ much greater than $Pd/TiO_2$ ≧ Pd/MgO ≅ $Pd/ZrO_2$. The effects of support composition on the catalytic properties of Pd are discussed in the light of current ideas concerning metal-support interactions and the acid-base properties of the support.

## 0903 Inorganic Hydrogen Compound Fuels

*REFER ALSO TO CITATION(S) 35156*

## 0904 Solid Waste And Wood Fuels

*REFER ALSO TO CITATION(S) 34431, 34461, 34516, 34533, 34665, 34988, 34990, 35081, 35432*

**34482 (DOE/CS/20231—1) Conversion of municipal solid waste to energy, Jacksonville, Florida, Phase I report.** (Systems Technology Corp., Xenia, OH (USA)). Jul 1981. Contract AC01-79CS0231. 237p. NTIS, PC A11/MF A01. Order Number DE82000808.

The concept feasibility study reported herein was sponsored by the US Department of Energy's (DOE) Urban Waste and Municipal Systems Branch. It is an objective of this Branch to assist in the development of new technology and to foster the commercialization of innovative concepts for energy recovery from municipal solid waste (MSW). Thus the DOE sponsored a program to evaluate and implement the Scientific Energy Engineering (SEE) auger combustion system. The system is a two chamber, starved-air incinerator so named because of the auger located within the primary chamber which tumbles and moves the waste through the system. A 250 tons per day (TPD) prototype facility located in Jacksonville, Florida, was tested and evaluated. The test report is included in its entirety as an attachment to this study. The commercial version of the system, with a capacity of 350 TPD, was developed by Boeing Engineering and Construction Company (BEC) which is licensed to design and market the system for SEE. The evaluation of applying resource recovery in the City of Jacksonville, Florida, involved the determination of the following: (1) the amount and characteristics of the solid waste; (2) the location and requirement of candidate energy customers and materials markets; (3) the applicable incineration/heat recovery and resource recovery technologies; and (4) the institutional, legal, and environmental requirements for constructing a facility. An implementation plan was developed to define the specific steps required to employ a waste-to-energy technology in the Jacksonville area.

**34483 (DOE/CS/20424—1) Energy recovery from municipal solid waste and sewage sludge using multi-solid fluidized bed combustion technology.** (Battelle Columbus Labs., OH (USA)). Jul 1981. Contract AC01-78CS20424. 210p. NTIS, PC A10/MF A01. Order Number DE82001142.

This study was initiated to investigate the recovery of energy from municipal solid waste (MSW) and domestic sewage sludge (DSS) simultaneously by using Battelle's multi-solid fluidized-bed combustion (MS-FBC) technology. The concept was to recover energy as high and low pressure steam, simultaneously. High pressure steam would be generated from flue gas using a conventional tubular boiler. Low pressure steam would be generated by direct contact drying of DSS (as 4% solids) with hot sand in a fluidized bed that is an integral part of the MS-FBC process. It was proposed that high pressure steam could be used for district heating or electricity generation. The low pressure steam could be used for close proximity building heat. Alternatively, low pressure steam could be used to heat wastewater in a sewage treatment plant to enhance sedimentation and biological activity that would provide a captive market for this part of the recovered energy. The direct contact drying or tubeless steam generation eliminates fouling problems that are common during heat exchange with DSS. The MS-FBC process was originally developed for coal and was chosen for this investigation because its combustion rate is about three times that of conventional fluidized beds and it was projected to have the flexibility needed for accomplishing tubeless steam generation. The results of the investigation show that the MS-FBC process concept for the co-utilization of MSW and DSS is technically feasible and that the thermal efficiency of the process is 76 to 82% based on experiments conducted in a 70 to 85 lb/h pilot plant and calculations on three conceptual cases.

**34484 (EPRI-CS—1983-Vol.1) Cofiring of refuse-derived fuel and coal at Oak Creek. Volume 1. Boiler corrosion evaluation. Final report.** Plumley, A.L.; Roczniak, W.R. (Combustion Engineering, Inc., Windsor, CT (USA)). Aug 1981. 247p. NTIS, PC A11/MF A01. Order Number DE81904238.

A 4000-hour controlled-temperature probe evaluation was conducted to determine the long term impact of co-firing coal and refuse derived fuel (RDF) on corrosion of boiler materials in Oak Creek Unit 7 of Wisconsin Electric Power Company (WEPCO). The evaluation was jointly sponsored by the Electric Power Research Institute (EPRI) and WEPCO. Two horizontal superheater probes are divided into two sections: a water-cooled supporting shank and the air-cooled sample section which consists of cylindrical 2 in. diameter specimens threaded together to form the test superheater element. The test probe metal temperature is regulated and monitored by means of thermocouples embedded in the specimen walls. The two waterwall probes each consist of five similar cylindrical test specimens mounted vertically in the plane of the furnace wall. The low-temperature probes have split ring specimens mounted around a central fluid-filled core, the temperature of which is maintained by means of an immersed cooling coil. Evaluations included weight loss, penetration, and metallurgical examination as well as chemical examination of selected deposits. While wastage increased with increasing metal temperatures, no significant wastage was attributable to the 10 to 15% replacement of coal by RDF. Future plans include slag and deposit analysis and exposure of additional probes.

**34485 (MASEC-R—81-062) MASEC industrial fuel-wood program.** Hohmann, M. (Mid-American Solar Energy Complex, Minneapolis, MN (USA)). Jul 1981. Contract AC02-79CS30150. 46p. (B—101-3). NTIS, PC A03/MF A01. Order Number DE82000461.

The MASEC Industrial Fuel Wood Program is designed not only to identify technical and institutional barriers to the use of wood for fuel, but to effectively reduce these barriers and the economic uncertainty they cause by providing business and industry with the type of information they need for preliminary planning purposes. This report is designed to provide information on resource availability, the types of equipment needed, sources of technical assistance, and the financial aspects of the potential investment. A listing of existing wood-fired systems is also included. A key component of the Industrial Fuel Wood Program is a net-cash-flow analysis based upon a life-cycle economic model that is used to evaluate new and retrofit wood-fired boiler installations. The model is currently set up to evaluate wood and/or oil-fired boilers and to provide comparisons of the two. The Industrial Fuel Wood Program relies heavily on widespread access to this computer software.

## 0906 Gaseous Waste Fuels

*REFER ALSO TO CITATION(S) 34244*

# 13 HYDRO ENERGY

## 1301 Resources And Availability

34486 **(FERC—0083) Planning status report: Allegheny River Basin, Pennsylvania-New York.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Electric Power Regulation). Mar 1981. 18p. NTIS, PC A02/MF A01. Order Number DE82000444.

The water resources of the Allegheny River Basin which covers 11,733 sq. mi. in Pennsylvania and New York are evaluated. Data are presented on existing and potential water resource development, on water use by existing and projected steam-electric generating facilities, and on the status of hydroelectric power plant licensing. Past and current planning studies are summarized. The information is current as of March 1981. (LCL)

34487 **(FERC—0084) Water resources appraisal for hydroelectric licensing: Jordan River Basin, Utah.** (Federal Energy Regulatory Commission, Washington, DC (USA)). Aug 1981. 75p. NTIS, PC A04/MF A01. Order Number DE82000416.

The water resources of the Jordan River Basin which covers approximately 3450 sq.mi. in north central Utah are evaluated. Data are presented on existing and potential water resource development, on water use by existing and proposed steam-electric generating plants, and on the status of hydroelectric power plant licensing. Past and current planning studies are summarized. The information is current as of August 1981. (LCL)

# 14 SOLAR ENERGY

34488 **(MASEC/R—81-074) Solar Energy Information Data Bank (SEIDB) Program. FY 1981 final project report.** (Mid-American Solar Energy Complex, Minneapolis, MN (USA)). Jun 1981. Contract AC02-79CS30150. 24p. (SDB—101-2). NTIS, PC A02/MF A01. Order Number DE81030054.

The background, program objectives, technical highlights, FY 81 program activity, and recommendations for the SEIDB are reviewed. (MHR)

## 1401 Resources And Availability

*REFER ALSO TO CITATION(S) 34939*

34489 (CONF-7811183—, pp 7-14) **Analysis and application of SOLMET radiation data.** Flood, C.A. Jr. (Auburn Univ., AL); Getz, R.R.; Taylor, S.E. 1978. NTIS, PC A10/MF A01. Order Number DE81014880.

From Conference on solar energy for livestock production; College Park, MD, USA (28 Nov 1978).

SOLMET is a comprehensive data base which provides quality controlled hourly solar radiation and meteorological data for 27 stations previously archived in the Card Deck 280 and Tape Data Family-14 systems. All future solar and meteorological data will be recorded in the SOLMET format. There are 27 stations throughout the United States in the SOLMET data file. Data cover the period 1 July 1952 through 31 December 1975 for most stations. An analysis of SOLMET hourly solar radiation was made. Data are presented as daily averages by climatic week.

34490 **(SOLAR/0010—81/08) August 1981 environmental data for sites in the National Solar Data Network.** (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). Aug 1981. Contract AC01-79CS30027. 176p. NTIS, PC A09/MF A01. Order Number DE82000071.

Environmental information collected at the sites of the National Solar Data Network is tabulated for each solar site. The sites are grouped into 12 zones, each of which consists of several adjacent states. The insolation table presents the total, diffuse, direct, maximum, and extraterrestrial radiation for the site. It also shows the ratio of total to extraterrestrial radiation. The temperature table gives the average, daytime, nighttime, maximum, minimum, and inlet-water temperature for the site. All of the passive and some active solar sites are equipped with wind sensors which provide information on wind speed and direction. For some sites, a humidity table provides relative humidity values for day and night. It also gives values for the maximum and minimum humidity for each day. A technical discussion of the instruments and measurements used to obtain the data is included. (LEW)

## 1403 Economics

*REFER ALSO TO CITATION(S) 34476, 34504, 34511, 34986, 34988, 34991, 35169, 35174, 35468*

34491 (CONF-801030—(Vol.2), pp 733-735) **Social impacts associated with the implementation of Brazil's PROALCOOL Program.** Caron, D. (PLANALSUCAR, Piracicaba, Brazil). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A brief description of the events and conditions leading to the implementation of the Brazilian PROALCOOL Program is presented. This paper describes 3 scenarios of ethanol production for the year 2000. They are based on presuppositions concerning the structure of transport systems and availability of petroleum. The demand level and corresponding impact on employment are discussed. (DMC)

34492 (CONF-801030—(Vol.2), pp 755-773) **Economic development, energy policy and alcohol.** Borges, J.M.M. 1980. (In Portuguese). NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

34493 (DOE/JPL—1060-46, pp 241-246) **Market assessment overview.** Habib-agahi, H. (Jet Propulsion Lab., Pasadena, CA). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The development of an integrated set of computer simulations, coupled with refined market data, has allowed tremendous progress in our ability to evaluate the worth of solar thermal parabolic dish systems. It is now possible to perform in-depth analyses of both electric and thermal market applications of these systems. The following market assessment studies were undertaken in 1980: regional analysis of the near term market for PD systems; potential early market estimate for electric applications; potential early market estimate for IPH/cogeneration applications; selection of thermal and electric application case studies for FY 1981.

34494 (DOE/JPL—1060-46, pp 247-250) **Cost goals.** Hoag, J. (Jet Propulsion Lab., Pasadena, CA). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The cost goal activities are reported for the point focusing parabolic dish program. In general, cost goals involve three tasks. First is determination of the value of the dish systems to potential users. Secondly, the cost targets of the dish system are set out. Finally, the value side and cost side are integrated to provide information concerning the potential size of the market for parabolic dishes. The latter two activities are reported.

34495 (DOE/JPL—1060-46, pp 251-253) **Assessment of the industrial cogeneration market for parabolic dish systems.** Doane, J.W. (Science Applications, Inc., Golden, CO). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The methodology of an examination of the value for parabolic dish solar thermal systems in cogeneration applications in the southwestern US is reported. The study is an attempt to approximate the economic demand curve for parabolic dish cogeneration systems, showing a potential amount sold as a function of price. The maximum allowable life-cycle system cost for the cogeneration

system is determined as the sum of the present value of fuels displaced plus the present value of revenues from exported power. (LEW)

**34496 (MASEC-R—81-046) State-level market analysis for active solar systems.** (Mid-American Solar Energy Complex, Minneapolis, MN (USA)). Jun 1981. Contract AC02-79CS30150. 346p. (A—101-1). NTIS, PC A15/MF A01. Order Number DE82001204.

An economic analysis of net present value (discounted cumulative cash flow), payback potential, and potential rate of return for proposed domestic hot water systems was completed for 54 sites in the Mid-American Region. The MASEC-1 model used in the analysis is a life-cycle costing computer program which determines the economic potential of a proposed investment considering system costs, fuel savings, tax savings, the effects of inflation, and the time value of money. Computer generated tables and graphics depict the cash flow and F-chart thermal analysis for each site, as well as tables of summary economic data. (LEW)

## 1404 Environmental, Legal, And Institutional Aspects

*REFER ALSO TO CITATION(S) 34435, 34492, 34510, 34985, 34991, 35168, 35174, 35432*

**34497 (BNL—29963) Modeling solar-energy systems for economic optimization.** Leigh, R.W. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 6p. (CONF-811030—2). NTIS, PC A02/MF A01. Order Number DE81030030.

From 4. world engineering congress; Atlanta, GA, USA (12 Oct 1981).

A simple analytic model of solar energy systems is presented which can describe how the performance of the system depends on collector area and storage capacity with surprising accuracy. The model can then be used to determine easily the optimal (lower cost) configuration of collector area and storage capacity, and to see how this configuration will change under various possible fuel, collector, or storage costs.

**34498** (CONF-801030—(Vol.2), pp 719-724) **Environmental implications of the large scale utilization of alcohol/fuels in the United States.** Bevilacqua, O.M.; Bernard, M.J. III; Maxfield, D.P. 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

This paper highlights the most significant findings of a major study undertaken to assess the environmental impacts - both positive and negative - associated with the large scale utilization of alcohol/gasoline blends and neat alcohol/gasoline blends and neat alcohol fuels for powering highway vehicles in the United States. In this assessment, the environment was considered to include natural resource, ecological, physical environment, healh and safety, and social-economic systems. The environmental assessment was based on the extrapolation and systematic analysis of existing data as to the characteristics of alcohol fuels and their performance in conventional engines. The major results and implications of this assessment are presented in this paper.

**34499** (CONF-801030—(Vol.2), pp 741-747) **Petroleum price parity and petroleum displacement value of ethanol motor fuels.** Rentz, R.L.; Timbario, T.J. (Mueller Associates, Inc., Baltimore, MD). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

This paper describes a methodology for determining the crude petroleum price at which agriculturally derived ethanol motor fuels (both neat and blends) would be cost competitive with unleaded gasoline. Concurrently, a methodology is presented for determining the potential petroleum displacement value of ethanol fuels. Examples of methodology applications are provided. A useful feature of this paper is that the reader may readily employ other assumptions and substitute alternate data to explore specialized cases.

**34500** (CONF-801030—(Vol.2), pp 775-779) **Swedish policy and decisions on the introduction of alternate motor fuels.** Brandberg, A.; Johanson, B.C. 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Policy developments in Sweden for the introduction of alternate fuels, such as alcohol fuels and gasohol, are discussed in this article. (DMC)

**34501 (CONF-8005180—) Integration of solar energy into utility-system planning and strategies: 1980-2000.** (Kansas Univ., Lawrence (USA). Applied Energy Research and Public Service Program). Jul 1980. 288p. NTIS, PC A13/MF A01. Order Number DE81028923.

From Conference on the integration of solar energy into utility system planning and strategies: 1980-2000; Topeka, KS, USA (11 May 1980).

The purpose of the conference was to address the following questions that the utility industry must face as they make short and long-range plans to meet the nation's energy needs: (1) How do utilities develop plans for solar energy in demand forecasting, plant expansion, capital requirements, load management, and consumer relations? (2) Which solar technologies will emerge as dominant in the future? (3) What rate of growth in the utilization of solar energy can be expected by utility managers? (4) How can utilities use information on developments in solar technology in their operations, planning, and management? (5) What part can utilities expect to play in the financing and control of major solar energy technologies? The views and information presented at the conference are recorded in 17 speeches and presentations.

**34502 (SAND—81-7034) Possible effects of government and industry standards on photovoltaic products liability.** Eisenstadt, M. (Sandia National Labs., Albuquerque, NM (USA); Eisenstadt (Mel) and Associates, Inc., Albuquerque, NM (USA)). Aug 1981. Contract AC04-76DP00789. 34p. NTIS, PC A03/MF A01. Order Number DE81031936.

Products liability law is becoming more favorable toward the defendant, after two decades in the opposite direction. Industry and government standards and regulations can affect liability lawsuits involving producers and sellers of photovoltaic (PV) equipment. Design and fabrication in accordance with such standards are admissable as evidence, but does not determine legal issues. In some states, compliance is presumption that ordinary care was used and that the product is not defective or unreasonably dangerous. Good standards can aid in litigation in at least three ways: (1) they indicate that an industry is making a good-faith effort to police itself, creating a positive image of the defendant; (2) although they tend to be considered minimums for product safety and the courts are not obligated to accept them as adequate, they do provide guidance; this is particularly important for completely new products; and (3) perhaps most important, standards are one element in determining if a product complies with the state of the art, which in some states, can be used as a defense.

## 1405 Solar Energy Conversion

*REFER ALSO TO CITATION(S) 34418, 34420, 34421, 34422, 34424, 34426, 34427, 34429, 34430, 34431, 34432, 34433, 34434, 34436, 34437, 34438, 34439, 34440, 34441, 34442, 34443, 34444, 34445, 34446, 34449, 34450, 34451, 34452, 34453, 34454, 34455, 34456, 34457, 34458, 34460, 34461, 34469, 34470, 34471, 34472, 34473, 34474, 34475, 34477, 34478, 34479, 34480, 34665, 34990, 35131, 35132, 35174, 35296, 35460, 35461, 35462, 35476*

**34503 (ANL/EES-TM—152) Technology assessment of solar energy systems: potential soil erosion effects of harvesting crop residues for energy production.** Torpy, M.F.; Habegger, L.J.; Snider, M.A.; Surles, T.G. (Argonne National Lab., IL (USA)). Jan 1981. Contract W-31-109-ENG-38. 38p. NTIS, PC A03/MF A01. Order Number DE82000149.

An evaluation is presented of the potential increase in erosion that could result from removal of the ground cover that the residues provide. The study indicates that removal of crop residues sufficient to produce 0.13 and 0.42 x $10^{15}$ Btu of end-use energy (as specified, respectively, in the two scenarios addressed by the Technology Assessment of Solar Energy Program) would have little

effect on soil erosion except in a few areas. An alternative scenario is addressed in which all reasonably available crop residues would be harvested to produce 1.5 x $10^{15}$ Btu of end-use energy. The approach used in evaluating erosion due to removal of residue is also described.

**34504** (CONF-801030—(Vol.1), pp 25-32) **Direct application of solar energy to alcohol fuel production.** Schwartz, D.M. (Enercorp, Inc., Denver, CO). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The author discusses the design, engineering and financial issues encountered in combining solar energy collection with alcohol production processes. A comparison is made between the energy consumption profile of a conventional facility and the solar powered one. The quantity and availability of solar energy versus the energy requirements of the process are plotted for several US Sunbelt sites. An economic analysis is projected illustrating the differences between conventional and solar facilities including initial capital requirements, annual cash flow, maintenance and operating expenses and net output versus land use. The issue of the net energy balance of alcohol fuels is addressed for fossil fueled, crop residue fueled, and solar fueled systems. Energy factors included in the equation are: field preparation for planting, crop maintenance, harvesting, transportation, renewable process fuels, non-renewable process fuels and the energy embodied in the alcohol process facility structure and equipment itself. It is believed that inclusion of the last listed item enables an even-handed analysis of conventional and solar facilities. Evaluations of solar powered systems that do not account for the additional energy required to produce and construct solar plants tend to give heavily biased results. Conversely, capital conserving fossil fuel powered plant evaluations that do not take into account the real escalation of energy prices due to scarcity are also likely to be inaccurate. The engineering criteria for the solar collectors themselves are explained with a comparison between flat-plate and concentrating types. Solar heat energy storage and retrieval strategies as applied to fermentation and distillation are also examined.

**34505** (CONF-801030—(Vol.1), pp 123-130) **Sorghums: viable biomass candidates.** McClure, T.A.; Arthur, M.F.; Kresovich, S.; Scantland, D.A. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Agronomic studies conducted at Battelle's Columbus Division to evaluate biomass and sugar yields of sweet sorghum are described and the major findings are summarized. Development opportunities for using sorghum cultivars as a large-scale energy crop are discussed. With presently available cultivars, sweet sorghum should produce 3500 to 4000 liters ethanol per hectare from the fermentable sugars alone. Conversion of the stalk fibers into alcohol could increase production by another 1600 to 1900 liters per hectare with existing cultivars. These yields are approximately 30 to 40% greater per hectare than would be obtained from above average yields of grain and stalk fiber with corn. There is reason to believe, that with hybrid sweet sorghum, these yields could be further increased by as much as 30%. Diminishing land availability for agricultural crops necessitates that maximum yields be obtained. Over the next decade, imaginative technological innovations in sorghum harvesting, processing, and crop preservation, coupled with plant breeding research should help this crop realize its full potential as a renewable resource for energy production.

**34506** (CONF-801030—(Vol.1), pp 131-138) **Productivity of selected plant species adapted to arid regions.** Nobel, P.S. (Univ. of California, Los Angeles). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The biomass potential of selected arid region species for alcohol production merits careful consideration. The basis for this interest is the current low agronomic use of arid lands and the potential productivity of certain species adapted to these lands. Plants displaying Crassulacean acid metabolism (CAM) are particularly interesting with reference to biomass for fuel in regions with low rainfall, because plants with this photosynthetic process are strikingly efficient in water requirements. For CAM plants, $CO_2$ fixation occurs primarily at night, when tissue surface temperature and hence transpirational water loss is less than daytime values. For Agave deserti in the Sonoran desert, the water-use efficiency (mass of $CO_2$ fixed/mass of water transpired) over an entire year is an order of magnitude or more larger than for C-3 and C-4 plants. This indicates how well adapted CAM species are to arid regions. The potential productivity per unit land area of CAM plants is fairly substantial and, therefore, of considerable economic interest for arid areas where growth of agricultural plants is minimal.

**34507** (CONF-801030—(Vol.1), pp 397-402) **Use of sunflower seed oil in diesel engined tractors.** Bruwer, J.J. (Dept. of Agriculture and Fisheries, Silverton, South Africa); Boshoff, B.V.D.; Hugo, F.J.C.; Fuls, J.; Hawkins, C.; van der Walt, A.N.; Engelbrecht, A.; du Plessis, L.M. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Research to date has shown that as far as maximum power and specific fuel consumption are concerned, sunflower seed oil, both undiluted and blended, compares satisfactorily with diesel fuel. Combustion-chamber deposits and gumming in the fuel system have not been a problem with the 20% sunflower seed oil; 80% diesel fuel blend. The atomization pattern of sunflower seed oil is inferior to that of diesel fuel, which could be the reason for the coking of injector tips. It is obviously desirable to obtain blends with physical properties comparable with diesel fuel specifications. Considering the promising results achieved, it is evident that sunflower seed oil, particularly in the ester phase, is potentially a highly suitable extender or replacement for diesel fuel. Some problems regarding incomplete combustion still remain to be solved and, therefore, sunflower seed oil cannot at this stage be recommended as a complete substitute fuel in tractor diesel engines.

**34508** (CONF-801030—(Vol.2), pp 797-800) **Some notes on studies of alcohol slops treatment in Taiwan.** Sang, S.L.; Wang, L.H.; Hwang, P.T.; Chuang, Y.T.; Kuo, Y.C.; Chang, C.Y. (Taiwan Sugar Research Inst., Tainan). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The main purpose of this paper is to review and describe some possible ways for the treatment of alcohol slops which have been carried out in the research laboratory or in the pilot plant. It will cover the process development for continuous production of yeast with cell recycle from alcohol slops and the treatment of alcohol or yeast waste by cultivation of a fungal strain. Both processes are considered economical and efficient in BOD reduction. The former shows a high productivity (gm/1-h) of yeast product, less power required, and higher BOD removal (from 30,000 to 15,000 ppM in 2 to 3 hours) especially when cell recycle technique is applied. The latter process is especially suitable to treatment for high BOD waste. The experimental results showed that about 75% BOD could be removed in 30 hours. Since the mycelium of the mold strain is very long, it could be harvested easily with a sieve of 100 to 200 mesh and the yield of the dry cells is 8 to 10 gm/1 of the waste. A 12-week preliminary feeding test has been carried out. No adverse effect on the growth and appearance of the laboratory rats. It could be expected to use as a good feed additive as yeast does.

**34509** (CONF-801030—(Vol.2), pp 815-821) **Use of winery wastes for the irrigation of sugar cane.** Leme, E.J.A.; Rosenfeld, U.; Baptistella, J.R. (IAA/PLANALSUCAR, Sao Paulo, Brazil). 1980. (In Portuguese). NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

**34510** (CONF-801030—(Vol.2), pp 823-827) **Economic aspects of alcohol production in the Southern Region of Brazil.** Mattuella, J. (Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil); Rask, N. 1980. (In Portuguese). NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

**34511** (CONF-801030—(Vol.2), pp 831-836) **Impact of Brazil's PROALCOOL on land prices and crop substitutions.** Pelin, E.R. (Univ. of Sao Paulo, Brazil). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

PROALCOOL-The Brazilian National Alcohol Program is anticipating and accelerating increases in the prices of lands in some states, given the analysis of current tendencies and availability of lands suitable for annual agricultural crops. In addition, the expansion of sugar cane between 1973/74 and 1978/79 was analyzed to identify the substitution effect whereby sugar cane displaced other crops destined for international markets and domestic consumption.

**34512** (CONF-801030—(Vol.2), pp 875-880) **Liquid fuels from biomass in Hawaii.** Ritschard, R.L.; Ghirardi, A.G. (Univ. of California, Berkeley). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

In this study the main issues related to the use of biomass as a source of liquid fuels in Hawaii are identified. One of the options immediately available is the use of alcohol fuels, especially ethanol, to displace part of the over 300 million gallons consumed anually in the state. Ethanol used either in mixture with gasoline (gasohol) or as the single fuel for internal combustion engines is technically feasible and becoming more economical as gasoline prices rise relative to those of alcohol. The main opportunities and problems associated with an alcohol fuels program for Hawaii are summarized here and a brief review of the available feedstocks and conversion technologies is presented. Finally, a comparison is made between the conditions prevailing in Brazil and Hawaii for the use of alcohol fuels, showing that other regions of the world may not be able to pursue the strategy adopted in Brazil.

**34513** (CONF-801030—(Vol.2), pp 881-888) **Alcohol fuels in New Zealand's energy future.** Titchener, A.L. (Liquid Fuels Trust Board, Wellington, New Zealand); Walker, B.V. 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

This paper reviews the structure of energy planning, research, and development in New Zealand, and the resource bases on which future energy supplies may be expected to depend. It addresses the problem of imported liquid fuels and the means of substituting for them. Recent decisions taken by the government are outlined. New Zealand is economically and strategically vulnerable to the supply of oil. A problem of increasing importance will be the supply of middle distillate fuels, especially diesel. In the longer term, and in the absence of discovery of indigenous oil or additional gas, the resource bases for synthetic liquid fuels in New Zealand will be coal or biomass or both. Prima facie the most obvious synthetic liquid fuels are liquid hydrocarbons. However, the alcohols have a number of advantages over synthetic hydrocarbon liquids, the most important of which are higher conversion efficiency (especially when used in spark-ignition engines) and known and relatively simple conversion technology. The present programme aimed at investigating means of substituting for imported liquid fuels is planned to embrace all reasonable options. Consequently it includes a significant body of research into the alcohols as engine fuels. The present paper has reviewed this research programme. Decisions on whether to move towards alcohol fuels must be ragarded as some way in the future. (DMC)

**34514** **(DOE/ER/10044—T1) Progress report to the Department of Energy in support of basic energy and policy research.** (Purdue Research Foundation, Lafayette, IN (USA)). 15 Jul 1981. Contract AS02-79ER10044. 326p. NTIS, PC A15/MF A01. Order Number DE81025882.

This progress report describes the accomplishments of the first and second years of the three year institutional grant received from the Department of Energy and describes the activities now envisioned for year three. Attachments detailing the highlights of the first and second years' accomplishments are included. Research areas include: light path of carbon reduction in photosynthesis; heat transfer in coal-ash slags; mechanism of plant cell enlargement in Gymnosperms, emulsion stability in enhanced oil recovery; selective transfer phenomenon in friction and wear; conceptual design of the Purdue Compact Torus/Passive Liner Fusion Reactor; integration of farm level alcohol production consistent with the economic and labor constraints of a farming operation, and newsmedia coverage of selected energy policy proposals. Separate abstracts have been prepared for selected attachments for inclusion in the Energy Data Base. (DMC)

**34515** (DOE/ER/10044—T1, pp 103p, Attachment A) **Energy policy research and information program. Publication Series EPRIP 80-4.** 15 Jul 1981. NTIS, PC A15/MF A01. Order Number DE81025882.

In Progress report to the Department of Energy in support of basic energy and policy research.

This volume contains an informal record of presentations given at the workshop. The subjects discussed include: crop residues and soil interaction, utilization of grains and by-products; systems concern in biomass/food production; salvaging corncobs for energy; drying corn with corncobs; alternate fuels for diesel tractors; new crops for energy; woody crops and residues; biology of biomass; research on alcohol from biomass; alcohol fuel combustion issues; the proper role of government in technical change; components and timing; institutions and their effects; food versus fuel controversy; and biomass R and D policy.

**34516** **(DOE/ET/11288—T5) Design handbook for residential woodburning equipment.** Maxwell, T.T.; Pruitt, T.M.; Maples, G.; Dyer, D.F. (Auburn Univ., AL (USA). Dept. of Mechanical Engineering). Jun 1981. Contract AS05-77ET11288. 192p. NTIS, PC A09/MF A01. Order Number DE81027150.

The following are discussed: the performance of the various types of woodburning appliances, heat output and efficiency, safety factors, and performance testing methods. Some special methods and hardware designed to aid in heat recovery from the basic unit and control systems are described. Cresote formation and related problems and considerations and methods to aid the designer of woodburning equipment are reviewed. (MHR)

**34517** **(DOE/ET/20009—T1) Design, construction, and operation of a full scale experimental anaerobic fermentation facility. Final report.** (United Technologies Corp., Windsor Locks, CT (USA). Hamilton Standard Div.). Jun 1981. Contract AC01-77ET20009. 235p. NTIS, PC A11/MF A01. Order Number DE81029028.

Under DOE Contract No. EG-77-C-4015, the Hamilton Standard Division of United Technologies Corporation has designed, constructed and operated a 25 ton per day anaerobic fermentation facility to evaluate the technical and economic viability of producing fuel gas and an animal refeed product from the residues of an environmental beef cattle feedlot. The system was built at a feedlot owned by Kaplan Industries Inc. (KII) in Bartow, Florida. KII contributed the site for system construction, the cattle to provide manure as system feedstock, certain capital equipment and the labor, utilities and supplies for the system operation. Florida Power Corporation contributed a 440 kW grid-connected engine/generator system. After operating conditions were reached during the summer of 1979, the system has been in continuous operation and has been producing between 3 to 5 cubic feet of methane per pound of volatile solids fed to the system. Product gas has been successfully utilized in: the system process boiler which maintains thermophilic operating temperature in the fermentors; a meat packing plant process boiler, cofired with fuel oil; and a 440 kW grid-

connected engine/generator system. Although the feeding trials that will establish the value of the dewatered effluent have been performed, the final results are not yet available. Initial operation of the system indicates that it will be a technically and economically viable process.

34518 (DOE/JPL—1060-46, pp 263-267) **Fuels and chemicals from biomass using solar thermal energy.** Giori, C. (IIT Research Inst., Chicago, IL); Leitheiser, R.; Wayman, M. 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The most significant nearer term opportunities for the application of solar thermal energy to the manufacture of fuels and chemicals from biomass are summarized, with some comments on resource availability, market potential and economics. Special consideration is given to the production of furfural from agricultural residues, and the future role of furfural and its derivatives as a replacement for petrochemicals in the plastics industry.

34519 **(DOE/JPL/955909—81/3) Module experimental process system development unit (MEPSDU). Quarterly report No. 3, June 1, 1981-August 31, 1981.** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.). 1981. Contract NAS-7-100-955909. 70p. NTIS, PC A04/MF A01. Order Number DE82000093.

The performance evaluation of the module experimental process system development unit (MEPSDU) module is summarized. Hailstone impact, wind loading, thermal cycling and humidity cycling tests are reported, as well as tests on cell response to interconnect failure and to short circuit/shading. Investigations of four alternate process steps - electroless nickel metallization, ion implantation, liquid precursor films for diffusion masks and dopants, and plasma etching of raw web - are discussed. The design of the development unit is described. Photovoltaic module production costs were projected for 1 MW/yr and 25 MW/yr production lines. Progress on the automated cell interconnect station is reported. (LEW)

34520 **(DOE/RA/50308—1) Feasibility study report for the Imperial Valley Ethanol Refinery: a 14.9-million-gallon-per-year ethanol synfuel refinery utilizing geothermal energy.** (Ultrasystems, Inc., Irvine, CA (USA); U.S. Alcohol Fuels, East Mesa, CA (USA)). Mar 1981. Contract FG07-80RA50308. 202p. NTIS, PC A10/MF A01. Order Number DE82000288.

The construction and operation of a 14,980,000 gallon per year fuel ethanol from grain refinery in the Imperial Valley of California is proposed. The Imperial Valley Ethanol Refinery (refinery) will use hot geothermal fluid from geothermal resources at the East Mesa area as the source of process energy. In order to evaluate the economic viability of the proposed Project, exhaustive engineering, cost analysis, and financial studies have been undertaken. This report presents the results of feasibility studies undertaken in geothermal resource, engineering, marketing financing, management, environment, and permits and approvals. The conclusion of these studies is that the Project is economically viable. US Alcohol Fuels is proceeding with its plans to construct and operate the Refinery.

34521 **(DOE/SERI—9234/3) Photovoltaic mechanisms in polycrystalline thin film silicon solar cells. Quarterly technical progress report No. 3, February 1-April 30, 1981.** Sopori, B. (Motorola, Inc., Phoenix, AZ (USA)). 29 Aug 1981. Contract AC02-77CH00178. 43p. NTIS, PC A03/MF A01. Order Number DE81030370.

Efforts are described in developing a technique for rapid identification of isolated line dislocations and dislocation networks in RTR ribbons. This was accomplished by extending the technique of Cu decoration to determine defect propagation in polycrystalline substrates. The basic characteristics of (100) textured surfaces are described, followed by a ray optics approach towards the analysis of textured surfaces, with and without AR coatings. The technique of optimization is demonstrated for a standard cell and an ultraviolet cell. (LEW)

34522 **(LBL—11983) Chemical process research and development program, FY 1980.** (Lawrence Berkeley Lab., CA (USA)). Mar 1981. Contract W-7405-ENG-48. 47p. NTIS, PC A03/MF A01. Order Number DE81030532.

This report contains summary highlights of the research programs in progress. The Chemical Process Research and Development Program deals with three principal application areas of chemistry: (1) production of synthetic fuels, (2) processing of effluent or recycled water and gas streams and/or feedstocks to achieve environmental compatibility, and (3) electrochemical energy storage. These projects have in common the use of principles of transport, thermodynamics, kinetics, separations and physical chemistry to improve fundamental mechanistic understanding and thereby to develop improved processing approaches. Separate abstracts have been prepared for each project for inclusion in the Energy Data Base. (DMC)

34523 (LBL—11983, pp 3.2-3.7) **Process development studies on the bioconversion of celluloses.** Blanch, H.W.; Wilke, C.R.; Dove, G.; Perez, J.; Sciamanna, A.F. Mar 1981. NTIS, PC A03/MF A01. Order Number DE81030532.

In Chemical process research and development program, FY 1980.

This program has concentrated on the hydrolysis of cellulose and hemicellulose to sugars and on their subsequent fermentation to ethanol for use as a liquid fuel. A range of candidate cellulosic materials, mainly in the form of agricultural residues, forest-produced residues and whole tree biomass, have been analyzed and assessed for yields of sugar and ethanol under various processing conditions. Processing concepts under study include chemical (acid) pretreatment of these cellulosic materials to remove lignin and hemicellulose; enzymatic and chemical hydrolysis to produce hexose sugars; and production of ethanol by fermentation. Important basic problems include the kinetics of enzymatic hydrolysis of cellulose, the physical and chemical nature of the raw materials, production and recovery of the enzymes involved, and the development of new organisms for direct conversion of cellulose to ethanol. Major developmental studies under the auspices of the Solar Energy Program include development of chemical treatment processes, studies on optimal cellulase production, enzymatic hydrolysis of hemicellulose and subsequent fermentation of the pentose sugars to ethanol, and optimization of a continuous-removal process for the ethanol fermentation using low pressure distillation. In all these studies, the economic impact of each process change is evaluated.

34524 **(PNL—3918) Technology assessment of solar energy systems: residential use of fuelwood in the Pacific Northwest.** Petty, P.N.; Hopp, W.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1981. Contract AC06-76RL01830. 72p. NTIS, PC A04/MF A01. Order Number DE82000046.

The evidence of impacts associated with the use of fuelwood for residential space heating in the region including the states of Washington, Oregon, and Idaho is identified and evaluated. The use of fuelwood for space heating was projected into the future, and then the potential size of the impacts that had been identified and estimated was evaluated. These projections are provided in five year increments beginning in 1980 and proceeding to the year 2000. Policy options are suggested which may mitigate the adverse impacts identified, while preserving the positive effect of reducing residential demand for energy derived from nonrenewable sources.

34525 **(PNL—3933) Technology assessment of solar energy systems: availability and impacts of woody biomass utilization in the Pacific Northwest.** Hopp, W.J.; Chockie, A.D.; Allwine, K.J. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1981. Contract AC06-76RL01830. 57p. NTIS, PC A04/MF A01. Order Number DE82000705.

The estimates of the biomass resource base in the Northwest are reviewed for comparison with scenarios used and a preliminary analysis of the issues involved in the collection and use of forest residues as an energy resource is presented. Four issues are reviewed that may serve to constrain the total amount of wood residues available for use as fuel. (MHR)

**34526 Sweet sorghum--a renewable source for energy for the United States.** Kresovich, S.; Jackson, D.R.; Lawhon, W.T. pp 237-243 of Bioresources for development: the renewable way of lif. King, A.; Cleveland, H.; Streatfield, G. (eds.). Elmsford, NY; Pergamon Press (1980).

From International conference on biopotentials for development; Houston, TX, USA (5 Nov 1978).

The authors present an overview of the cultural practices and economics which occur as sweet sorghum is grown with energy as the end product. 7 refs.

**34527 (SAND—81-1950) Fundamental studies of grain-boundary passivation in polycrystalline silicon with application to improved photovoltaic devices.** Seager, C.H.; Ginley, D.S. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1981. Contract AC04-76DP00789. 80p. NTIS, PC A05/MF A01. Order Number DE82000825.

Theoretical studies of grain boundaries subject to uniform illumination have been completed. Barrier heights and recombination velocities for silicon grain boundaries have been calculated and are shown to be in good agreement with recently obtained transport measurements on uniformly illuminated silicon bicrystals. Improved calculations of the Hall effect in polycrystalline solids are also presented along with assessments of the ability of effective circuit models to account for the anomalously low carrier concentrations measured in small grain polycrystalline silicon. Preliminary optimization of some new methods for hydrogen passivation has been completed. Almost complete removal of EBIC grain boundary losses can now be achieved in times as short as twenty minutes. In addition, progress has been made in the identification and characterization of infrared vibrational modes associated with grain boundary-bonded hydrogen. The effects of fluorine and oxygen treatments on silicon grain boundaries have also been determined. These agents appear to increase grain boundary potential barrier heights in n-type silicon in marked contrast to the effect of hydrogen.

**34528 (SERI/PR—8136-1-T5) Development of high-efficiency cascade solar cells. Annual report, July 1980 to June 1981.** Timmons, M.L.; Bedair, S.M.; Hutchby, J.A.; Hauser, J.R.; Simons, M. (Solar Energy Research Inst., Golden, CO (USA); Research Triangle Inst., Research Triangle Park, NC (USA). Semiconductor Research Dept.; North Carolina State Univ., Raleigh (USA). Dept. of Electrical Engineering). Jul 1981. Contract AC02-77CH00178. 89p. NTIS, PC A05/MF A01. Order Number DE81029633.

The principal objective of research conducted under this contract during the past twelve months has been the development and fabrication of two junction cascade solar cells in two different III-V semiconductor materials systems: AlGaAs/GaAs and AlGaAsSb/GaAsSb. Liquid phase epitaxy (LPE) has been successfully used to fabricate experimental cascade cells in both of these materials systems. Additional research has been carried out using organometallic/chemical vapor deposition (OM/CVD) growth technology.

**34529 (SERI/TR—8142-4-T3) Preparation and characterization of hydrogenated amorphous silicon. Final technical report, 1 June 1980-31 May 1981.** Donovan, T.M. (Solar Energy Research Inst., Golden, CO (USA); Naval Weapons Center, China Lake, CA (USA)). 21 Aug 1981. Contract AC02-77CH00178. 22p. NTIS, PC A02/MF A01. Order Number DE81030973.

Work is summarized on the deposition and characterization of DC magnetron sputtered amorphous silicon-hydride and an evaluation of its potential as a solar material. Infrared vibrational spectra of films deposited in the 200 to 300°C temperature range showed that hydrogen incorporated mainly as SiH. Doping with nitrogen or phosphorus is found to be ineffective in increasing conductivity or photoconductivity. During deposition, DC bias of the substrate was successful in reducing interface contamination and improving the coalescence of the condensing Si. High levels of defects or dangling bonds are inferred from both optical and transport measurements made on bias - deposited, single-mode, structurally homogeneous SiH films. (LEW)

**34530 (SERI/TR—9190-1-T3) Investigation of solar cells base on $Cu_2O$. Final progress report, June 1, 1980-May 31, 1981.** Olsen, L.C. (Joint Center for Graduate Study, Richland, WA (USA)). Jul 1981. Contract AC02-77CH00178. 50p. NTIS, PC A03/MF A01. Order Number DE81030274.

Investigations of $Cu_2O$ solar cells concentrated on junction fabrication. In particular, studies were carried out with the objective of determining if it is possible to fabricate a $Cu_2O$ junction with a built-in voltage significantly greater than 1 eV. Low level efforts were devoted to $Cu_2O$ substrate fabrication and characterization, and n-type film studies for $Cu_2O$ hetero-junctions. A $Cu_2O$ cell structure based on a Tl/$Cu_2O$ Schottky barrier was selected for a detailed study. Dark I-V analyses were carried out for thick film Tl/$Cu_2O$ Schottky barriers as a function of temperature. Concentration profiles were obtained for Tl/$Cu_2O$ structures with Auger Spectroscopy.

**34531 Annealing and anomalous high-energy electron irradiation effects in low-cost silicon $N^+P$ solar cells.** Garlick, G.F.J.; Kachare, A.H. (267 South Beloit Avenue, Los Angeles, California 90049). *Applied Physics Letters ;* **39**: No. 6, 501-503(15 Sep 1981).

Silicon solar cells of $N^+P$ type made from multiple ingots grown from a single crucible were either subjected to 1-MeV electron irradiation (fluence up to $10^{16}$ electrons/cm$^2$) and then annealed at 450 °C for 20 min or to the annealing alone with no electron irradiation. Electron irradiation gave the expected degradation of longer-wavelength cell response but at shorter wavelengths produced a marked enhancement of response with peak change of some 40% at 0.44 μm. Subsequent thermal anneal at 450 °C reduced the long-wavelength degradation, but the enhancement at shorter wavelengths persisted. Excitation at the shorter wavelength is predominantly in the $N^+$-diffused layer and to some extent in the junction region of the cell. Anneal of unirradiated cells at 450 °C also produced the shorter-wavelength enhancement at about half of that due to electron irradiation and more enhancement into the longer wavelength region (up to 0.8 μm), finally giving a small degradation. These effects in the different cell regions are attributed to a decrease in interstitial oxygen-impurity complexes which act as deep recombination levels and the formation of substitutional oxygen-silicon vacancy centers which act as donors. The investigations indicate that thermal regimes during cell processing can produce cell spectral characteristics that might be further improved by modification of such regimes.

**34532 Transparent-conducting coating for a-Si:H based devices.** Ovadyahu, Z.; Wiesmann, H. (Brookhaven National Laboratory, Upton, New York 11973). DE-AC02-76CH00016. *Journal of Applied Physics ;* **52**: No. 9, 5865-5866(Sep 1981).

A simple procedure for the application of a transparent-conducting coating onto a-Si:H devices is described. Results pertaining to a-Si:H solar-cell heterojunctions incorporating such coatings are given and discussed.

**34533 Energy relationships in the forest products industry.** Jordan, R.K. pp 185-195 of Proceedings of third annual energy seminar. Erie, PA; Gannon University (1981).

From 3. annual energy seminar; Erie, PA, USA (31 Mar 1981).

The loss of wood wastes resulting from the harvesting of 300 million TPX of wood in the US is discussed. Varying compositions of wood and bark for hardwoods and soft woods are described. The heating values of wood, bark, and the components of wood (cellulose, hemicellulose, and lignin) are indicated. The economic impact of wastes in sawmills and pulp mills are briefly discussed. The wood pulping process is examined in some detail. The potential of using byproduct cellulose as animal feed and the effort directed to converting wood (not bark) to ethanol are noted. (MCW)

**34534 Wood and bark delignification: its potential for synthetic fuels.** Bucholtz, M.; Jordan, R. pp 197-205 of Proceedings of third annual energy seminar. Erie, PA; Gannon University (1981).

From 3. annual energy seminar; Erie, PA, USA (31 Mar 1981).

The percentages of components in wood and bark (cellulose, hemicellulose, lignin, and extractives) in hardwood and softwoods are tabulated. A process is being developed for delignifying wood which minimizes hydrolysis of hemicellulose while removing lignin at a high rate. If lignin and extractables can be recovered without substantial chemical modification, the aromatic groups suggest a vast potential source of liquid and gaseous fuels and chemicals. The economics and energy efficiency of the process are discussed and percentages of recovered energy and energy efficiency are calculated per ton of product. These data are compared to the percentages of materials recovered and energy efficiency for a conventional kraft process. Specifically, yields of lignin, potential of animal feed, production of ethanol, and production of wood pulp in the process are discussed. (MCW)

34535 **Energy from Newfoundland's forest biomass: a research and development program.** van Nostrand, R.S. St. John's, Newfoundland; Newfoundland Forest Research Center (1980). 42p. (N-X—180).

The forests of Newfoundland have a potential for making a substantial contribution to the energy needs of the Province. Eight sources of biomass suitable for the production of energy are identified, and quantities estimated. Major sources offering immediate potential are the under-utilized hardwoods which comprise 34 million $m^3$ of the Island's forests, and the dead and dying softwoods amounting to 22 million $m^3$ as a result of a severe Island-wide spruce budworm infestation. Estimates of biomass in proximity to the three newsprint mills at Grand Falls, Corner Brook and Stephenville are given. The Newfoundland Forest Research Centre is actively involved in the development of a research and development program in Energy from the Forest (ENFOR) for the Province. Strategies are outlined in a plan of action which describes completed, on-going, and proposed projects over the 6-year life of the ENFOR program. Through this program an attempt will be made to resolve the more important problems regarding the supply and utilization of forest biomass for energy production.

34536 **(DOE/CS/30156—T1) Passive solar working for you naturally: information manual.** (Iowa Energy Policy Council, Des Moines (USA). Iowa Solar Office). [nd]. Contract AC02-79CS30156. 220p. NTIS, PC A10/MF A01. Order Number DE81030947.

The elements of energy efficient house design are presented, and passive solar components and systems are discussed, including fan-assisted passive systems and passive cooling. Modifying existing residences for energy conservation, and passive and active solar retrofitting are discussed. Some construction details and financial considerations are described. Included are lists of sources for passive solar house plans, manufacturers of movable insulating products, and Iowa solar industry professionals and installations. (LEW)

## 1406 Photovoltaic Power Systems

*REFER ALSO TO CITATION(S) 34502*

34537 **(DOE/CS/30203—T5) Experimental and analytical systems studies of a combined thermal-photovoltaic residential solar system. Technical status report No. 3.** (Arizona State Univ., Tempe (USA)). 1980. Contract AC03-79CS30203. 10p. NTIS, PC A02/MF A01. Order Number DE81029539.

Technical progress reported included testing of the corrosion resistance of a turbine flow meter and parametric studies using computerized simulation of a combined thermal-photovoltaic concentrating collector, thermal storage tank, absorption air conditioner with auxiliary heater, and a load. Also, work on a test facility, including data processing equipment and a cooling load simulator, is reported. (LEW)

34538 **(DOE/ET/20279—154) Data report for the Northeast Residential Experiment Station, June 1981.** Russell, M.C.; Raghuraman, P.; Farrell, J.J. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Aug 1981. Contract AC02-76ET20279. 14p. NTIS, PC A02/MF A01. Order Number DE82000068.

The Residential Experiment Stations of the Solar Photovoltaic Residential Project have been designed by MIT Lincoln Laboratory under Department of Energy sponsorship to develop residential photovoltaic systems and to gather and disseminate performance data for the photovoltaic community, cognizant institutions and, ultimately, the public. Physical performance data for the month of June 1981 obtained from photovoltaic energy systems under tests at the Northeast Residential Experiment Sataion in Concord, Massachusetts are tabulated.

34539 **(SAND—81-7088/2) Intermediate photovoltaic system application experiment operational performance report. Volume 2 for Beverly High School, Beverly, MA.** (Sandia National Labs., Albuquerque, NM (USA); Boeing Computer Services Co., Seattle, WA (USA)). Sep 1981. Contract AC04-76DP00789. 21p. NTIS, PC A02/MF A01. Order Number DE82000811.

For the month of July 1981, performance data are listed and graphed for an intermediate photovoltaic system at a high school in Massachusetts. The energy production, incident solar energy and efficiency are given, and the daily energy production and efficiency, and energy production as a function of power and voltage are graphed. The output of the power conditioner, insolation, heating and cooling loads, temperature and wind data, and the number of freeze-thaw cycles are given. (LEW)

34540 **(SAND—81-7100-Vol.1) Intermediate photovoltaic system application experiment operational performance: executive summary. Volume 1, for Newman Power Station, El Paso, TX.** (Sandia National Labs., Albuquerque, NM (USA)). Aug 1981. Contract AC04-76DP00789. 9p. NTIS, PC A02/MF A01. Order Number DE81031934.

The following data are given for a 20 kWp photovoltaic flat panel power system for an uninterruptable power supply load: total electrical energy produced during the month of June 1981, and for each day of the month; total incident solar energy in the plane of the collector during the month and for each day of the month; array efficiency; and monthly average direct normal insolation during the month during daylight hours. (LEW)

## 1407 Solar Thermal Power Systems

*REFER ALSO TO CITATION(S) 34493*

34541 **(DOE/CS—4042-2) Solar thermal energy systems. Annual technical progress report FY 1980.** (Solar Energy Research Inst., Golden, CO (USA)). Jul 1981. Contract AC02-77CH00178. 157p. NTIS, PC A08/MF A01. Order Number DE81029295.

The technical progress in the projects of the Solar Thermal Energy Systems Program for FY 1980 is summarized. Each project description includes a brief history, significant achievements, future activities, and a forecast of anticipated achievements. Point focus, central receiver and line-focus technologies are discussed as well as research and advanced development of components, materials, fuels and chemicals, and solar ponds. (LEW)

34542 **(DOE/ET/20535—T3) Line-focus solar-central power systems. Second quarterly review.** (General Atomic Co., San Diego, CA (USA)). 10 May 1979. Contract AC03-78ET20535. 90p. NTIS, PC A05/MF A01. Order Number DE81024188.

Progress with a slat-type line-focus solar central power system is reviewed with the use of numerous outlines and diagrams. Fabrication concepts for the primary concentrator, design requirements, and costs are presented. Each concentrator is fixed with a tracking receiver at the focus. The design of the heat receiver, including the linkage support, is given. Progress with the heat transfer and electric power generating systems is presented also. Subsystem parametric analyses are outlined for the collector, receiver, heat transport, power, energy storage, and master control subsystems, and system characterization studies are presented, including preliminary cost estimates. (LEW)

**34543** **(DOE/JPL—1060-46) Parabolic-dish solar-thermal power: annual program review.** (Jet Propulsion Lab., Pasadena, CA (USA)). 1 May 1981. Contract AT04-81AL16228. 302p. NTIS, PC A14/MF A01. Order Number DE81028373.

Separate abstracts were prepared for 30 papers in these proceedings. Two panel discussions broadly covering technology development issues and application/user needs and a luncheon speech about the energy picture in California are also incuded. (LEW)

**34544** (DOE/JPL—1060-46, pp 5-9) **SCSE Organic Rankine engine.** Boda, F.P. (Ford Aerospace and Communications Corp., Newport Beach, CA). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The Organic Rankine Cycle (ORC) engine currently under development for the Small Community Solar Thermal Power Experiment (SCSE) for JPL/DOE is described. This engine is the heart of a Power Conversion Subsystem (PCS) located at the focal point of a sun-tracking parabolic dish concentrator. The ORC engine employs a single-stage axial-flow turbine driving a high speed alternator to produce up to 25 kW electrical output at the focus of each dish. The organic working fluid is toluene, circulating in a closed-loop system at temperature up to 400°C (750°F). Design parameters, system description, predicted performance and program status are described.

**34545** (DOE/JPL—1060-46, pp 11-15) **Jay Carter Enterprises, Inc. Steam engine.** Nesmith, B.J. (Jet Propulsion Lab., Pasadena, CA). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The Small Community Solar Power Experiment (SCSE) has selected an organic rankine cycle (ORC) engine driving a high speed permanent magnet alternator (PMA) as the baseline power conversion subsystem (PCS) design. The high frequency alternating current from the PMA is rectified and inverted to grid quality electricity. The back-up conceptual PCS design is a Jay Carter steam engine driving an induction alternator delivering power directly to the grid. This paper traces the development of Carter's automotive reciprocating simple Rankine cycle steam engine is traced and how an engine of similar design might be incorporated into the SCSE is discussed. A description of the third generation automotive engine is included along with some preliminary test data. Tests were conducted with the third generation engine driving an induction alternator delivering power directly to the grid. The purpose of these tests is to further verify the effects of expander inlet temperature, input thermal power level, expansion ratio, and other parameters affecting engine performance to aid in the development of an SCSE PCS.

**34546** (DOE/JPL—1060-46, pp 17-22) **Steam engine research for solar parabolic dish.** Demler, R.L. (Foster-Miller Associates, Inc., Waltham, MA). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

A steam engine design and experimental program exploring the efficiency potential of a small 25 kW compound reheat cycle piston engine is discussed. An engine efficiency of 35% is estimated for a 700°C steam temperature from the solar receiver.

**34547** (DOE/JPL—1060-46, pp 23-35) **Solar Brayton engine/alternator set.** Six, L.; Elkins, R. (Garrett Turbine Engine Co., Phoenix, AZ). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

Garrett's work on the Mod 0 solar Brayton engine/alternator set is being redirected to utilize solarized components of the automotive advanced gas turbine (AGT) being developed by Ford and Garret under contract to NASA. The new configuration is referred to as the Mod I. Commercialization of solar Brayton engines thus should be enhanced not only by relating the design to an engine expected to reach the high quantity, low cost production rates associated with the automotive market, but also by the potential the AGT components provide for growth of efficiency and power rating. This growth would be achieved through use of ceramics in later versions making operation possible at temperatures up to 2500°F. The longer program duration and higher cost of the Mod I is considered compatible with the extended schedule of the application and the system test program for which the Brayton engine/alternator set is first intended. Subject to funding availability, the initial solarized AGT should be under test by November 1981, and a complete Mod I engine/alternator set deliverable approximately one year later. The Mod I will operate at 1500°F turbine inlet temperature (TIT) and produce 23 kW shaft output power at about 32% shaft efficiency. Growth versions incorporating ceramic parts will be capable of operating at 2100 to 2500°F TIT and should develop 51 to 71 kW shaft power at efficiencies from 40 to 48%.

**34548** (DOE/JPL—1060-46, pp 37-44) **First phase testing of solar thermal engine at United Stirling.** Percival, W. (United Stirling, Inc., Alexandria, VA); Nelving, H.G. 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The design of an experimental double-acting 40 kW Stirling engine is described. The design objective was to achieve a reliable experimental engine for the development of specific components such as the heater head, piston rod seals, piston rings and control systems. The results of acceptance, control and functional testing are given. (LEW)

**34549** (DOE/JPL—1060-46, pp 47-50) **Non-heat pipe receiver/P-40 Stirling engine.** Haglund, R.A. (Fairchild Stratos Div., Manhattan Beach, CA). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

A project to demonstrate the technology for a full-up hybrid dish-Stirling Solar Thermal Power system is described. Overall solar-to-electric efficiency for the dish-Stirling system demonstration is approximately 30%. Hybrid operation is provided by fossil fuel combustion augmentation, which enables the Stirling engine to operate continuously at constant speed and power, regardless of insolation level, thus providing the capability to operate on cloudy days and at night. The Non-Heat-Pipe Receiver/P-40 Stirling Engine system will be installed and operated on the JPL Test Bed Concentrator. A 25-kW direct-driven induction-type alternator will be mounted directly to the P-40 engine to produce to a 60-Hz, 460-480-volt output.

**34550** (DOE/JPL—1060-46, pp 51-56) **Heat pipe solar receiver with thermal energy storage.** Zimmerman, W.F. (General Electric Co., Evendale, OH). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

A heat pipe solar receiver (HPSR) Stirling engine generator system featuring latent heat thermal energy storage, excellent thermal stability and self regulating, effective thermal transport at low system $\Delta T$ is described. The system has been supported by component technology testing of heat pipes and of thermal storage and energy transport models which define the expected performance of the system. Preliminary and detailed design efforts have been completed and manufacturing of HPSR components has begun. The modification of a Stirling engine for operation on condensing sodium vapor is required during 1981 in order that the system can be committed to a solar test at an early date. Additional developments will include the later design, construction and test of a flame impingement combustor which can be directly added to the existing system without major modifications. A progressive development of this first prototype toward low cost, mass production hardware is expected for wide solar applications.

**34551** (DOE/JPL—1060-46, pp 57-65) **Development of an 85-kW (thermal) air Brayton solar receiver.** Greeven, M. (AiResearch Manufacturing Co. of California, Torrance); Owen, W. 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The results of the air Brayton solar receiver program from its inception through December 1980 is discussed. The design requirements, concept, and significant analysis upon which the receiver is based are described briefly, and the fabrication processes that have been utilized in the construction of the prototype receivers are described. The receiver test and evaluation phase is discussed. (LEW)

**34552** (DOE/JPL—1060-46, pp 67-74) **Development of an 85-kW (thermal) steam Rankine solar receiver.** Wright, C.C. (AiResearch Manufacturing Co. of California, Torrance); Bank, H. 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The final design goals and conditions for the steam Rankine solar receiver are summarized. Construction details of the receiver are described and the performance for a steam/electric application is estimated. Methods are discussed for adapting the SRSR to industrial process steam applications. Preliminary test results are given. (LEW)

**34553** (DOE/JPL—1060-46, pp 75-79) **Organic Rankine cycle receiver development.** Haskins, H.J. (Ford Aerospace and Communications Corp., Newport Beach, CA). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

A solar receiver is being developed for use with an organic Rankine cycle (ORC) engine as part of the Small Community Solar Experiment (SCSE). The selected receiver concept is a direct-heated, once-through, monotube boiler operated at supercritical pressure. The cavity is formed by a cylindrical copper shell and backwall, with stainless steel tubing brazed to the outside surface. This core is surrounded by lightweight refractory insulation, load-bearing struts, and an outer case. The aperture plate is made of copper to provide long life by conduction and reradiation of heat away from the aperture lip. The receiver thermal efficiency is estimated to be 97% at rated conditions (energy transferred to toluene divided by energy incident on aperature opening). Development of the core manufacturing and corrosion protection methods is complete with development testing of the core to be completed in January 1981. A prototype receiver will be supplied in March 1981 for integration and test at the engine supplier's facility.

**34554** (DOE/JPL—1060-46, pp 191-196) **Development of the Small Community solar power system.** Babbe, R.H. (Ford Aerospace and Communications Corp., Newport Beach, CA). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The status of the Small Community Solar Thermal Power Experiment (SCSE Program) is presented. Current activities on the Phase II single/module development plant. A description of the various subsystems and components is given with particular emphasis on the unmanned microprocessor-based plant control subsystem. Latest performance figures are given for the 1 MW/sub e/ plant, based on 56 power modules, each consisting of a G.E. 12m Low Cost Concentrator, a FACC cavity receiver, a Barber-Nichols Organic Rankine power conversion subsystem and a ground-mounted solid-state rectifier. Overall plant efficiency at rated conditions is 15.8%. Advanced glass concentrator designs yield 20% overall efficiencies.

**34555** (DOE/JPL—1060-46, pp 197-203) **Site participation in the Small Community experiment.** Holbeck, H.J.; Fellows, M. (Jet Propulsion Lab., Pasadena, CA). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The Small Community Solar Thermal Power Experiment (SCSE) has been planned to test a small, developmental solar thermal power plant in a small community application. The baseline plan is to install a field of parabolic dishes with distributed generation to provide 1 MWe of experimental power. Participation by the site proposer is an integral element of the experiment; the proposer will provide a ten-acre site, a connection to the electrical distributional system serving the small community, and various services. In addition to the primary participant, site study efforts may be pursued at as many as five alternative sites. In 1980, 44 proposals for the site participation in the SCSE, representing 24 states, were received by the US Department of Energy (DOE). The extent and quality of the responses provide a great deal of encouragement regarding public interest in alternative energy in general and particularly in this solar thermal experiment. The 44 proposals represented a wide variety of potential site participants with respect to size, type of community, utility characteristics and geographic distribution. Following evaluation, DOE selected six geographically-dispersed site finalists and completed further evaluation of sites in mid-1980. Site selection by DOE has been delayed pending programmatic considerations.

**34556** (DOE/JPL—1060-46, pp 205-208) **Definitive design of the solar total energy large-scale experiment at Shenandoah, Georgia.** Hunke, R.W.; Leonard, J.A. (Sandia National Labs., Albuquerque, NM). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The US Department of Energy, with Sandia National Laboratories providing technical support and management, is now starting construction of a Solar Total Energy Large Scale Experiment at Shenandoah, Georgia. The Solar Total Energy System (STES) is designed with capacity to supply electricity and thermal energy to a knitwear plant at the Shenandoah site. The system will provide 400 kilowatts electrical and 3.5 megawatts thermal energy. The STES is a cascaded total energy system configuration. It uses parabolic dish collectors and a steam turbine-generator. The electrical system will be grid-connected to the Georiga Power Company system.

**34557** (DOE/JPL—1060-46, pp 209-213) **JPL isolated application experiment series.** Levin, R.R. (Jet Propulsion Lab., Pasadena, CA). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The goal of the Applications Element of the Thermal Power Systems Project is to establish the technical, operational, and economic readiness of parabolic dish power systems for a variety of applications in the power range below 10 MWe. Power systems are being developed and tested to the point where commercialization efforts can lead to successful market penetration. A key element in this strategy is the use of experiments to test hardware and assess operational readiness. The JPL Isolated Application Experiments are described and their objectives discussed.

**34558** (DOE/JPL—1060-46, pp 187-189) **Small Community Solar Thermal Power Experiment.** Kiceniuk, T. 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The experimental program plan is briefly summarized, and each of the three proposed expermental plants are briefly described: a tower-focus plant, a field of parabolic dishes with steam piped to a central turbine-generator unit, and a field of parabolic dishes with a Stirling cycle engine/generator unit at the focus of each dish. The distributed generation system was selected for further work. (LEW)

34559 **(DOE/SF/10499—T51) 10 MWe solar thermal central receiver pilot plant. Solar facilities design integration: site plot plan (RADL item 7-2).** (McDonnell Douglas Corp., Huntington Beach, CA (USA); Stearns-Roger Engineering Co., Denver, CO (USA)). Sep 1979. Contract AC03-79SF10499. 8p. NTIS, PC A02/MF A01. Order Number DE81029790.

The geographic location and general layout of the Barstow Solar Pilot Plant are shown. (LEW)

34560 **(DOE/SF/10499—T52) 10 MWe solar thermal central receiver pilot plant. Solar facilities design integration: general arrangement plans (RADL item 7-3).** (McDonnell Douglas Corp., Huntington Beach, CA (USA); Stearns-Roger Engineering Co., Denver, CO (USA)). Sep 1979. Contract AC03-79SF10499. 27p. NTIS, PC A03/MF A01. Order Number DE81029837.

Preliminary drawings are provided of the plot plan, core area, water treatment area, and the warehouse plan, elevations and sections for the Barstow-Solar Pilot Plant. (LEW)

34561 **(SAND—81-0572C) Potential for using parabolic trough collectors to supplement power-cycle boilers.** Schimmel, W.P. Jr.; Lukens, L.L. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 17p. (CONF-811101—3). NTIS, PC A02/MF A01.

From Winter annual meeting of the ASME Technology and Society Division; Washington, DC, USA (15 Nov 1981).

An analysis has been made to the potential for using a parabolic trough solar collector system for preheat and boiling in a power generation cycle. The advantage of such a system is that solar energy is used to heat the water in a steam-Rankine cycle device up to the superheat regime, thus displacing the fossil fuel usually required. The temperature associated with this portion of the power cycle is typically on the order of 320°C (600°F) or less, which makes it compatible with current parabolic trough collector systems. A system model which lends itself to optimization studies has been constructed and exercised over a range of the multiparameter space involved. The collector field, storage, supplementary fossil boiler and superheater, and turbine/generator have been traded off to obtain a series of economically optimal systems for various years and solar fractions.

34562 **(SAND—81-0781) Fire hazard study of the Coolidge, Arizona, solar-powered irrigation facility.** Sanders, G.A. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1981. Contract AC04-76DP00789. 38p. NTIS, PC A03/MF A01. Order Number DE81031935.

A fault tree analysis of the Coolidge, Arizona, solar powered irrigation facility has been performed to study the causes and probability of fire. The analysis identifies the component malfunctions and the events which contribute to fires while quantifying the fire probabilities. Uncertainties are identified and recommendations for reducing the probability of fire are specified.

34563 **(SAND—81-1025) Use of Sandia's Central Receiver Test Facility as a high-intensity heat source for testing missile nose-cone (Radome) radar systems.** Porter, D.R. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1981. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01. Order Number DE82000968.

A series of tests at Sandia's Central Receiver Test Facility in support of the US Navy's SM-2 Blk 2 Radome Improvement Program is described. The CRTF was the source of high-intensity solar radiation for testing onboard radar-tracking systems under heating conditions intended to simulate those that occur in supersonic flight. Also discussed are the hardware used and the software developed at the CRTF.

## 1408 Ocean Thermal Gradient And Salinity Gradient

### Power Systems

34564 **(LBL—13208) Current measurements off Keahole Point, Hawaii: application to OTEC-1 ocean test platform.** Harms, V.W. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 11p. (CONF-810622—9). NTIS, PC A02/MF A01. Order Number DE81030539.

From 8. ocean energy conference; Washington, DC, USA (7 Jun 1981).

Detailed current measurements from the OTEC-1 vessel permits a preliminary analysis to be made of current induced hydrodynamic loads on the cold water pipe and hydrodynamic mixing along the trajectory of the mixed sea-water plume. The measured equilibrium depth of the plume agrees well with that predicted by the plume model and occurs near the base of the ocean mixed layer. Ocean turbulence is found to provide some mixing. Several possible causes for excessive hydrodynamic loading on the cold water pipe are enumerated. (LEW)

34565 **Ocean Thermal Energy Conversion.** Wilde, P. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Earth Sciences ;* **3**: No. 1, 1-3(Mar 1980).

The three basic options for OTEC systems are reviewed. These include a moored plant with a submarine electric transmission cable, a grazing platform for generating power which is then used to manufacture a product on board, and the land-based plant in which sea water is piped in. Four major classes of environmental concerns associated with OTEC deployment are considered: redistribution of oceanic properties, chemical pollution, structural effects, and socio-economic and legal issues.

## 1409 Solar Thermal Utilization

*REFER ALSO TO CITATION(S) 34311, 34493, 34496, 34504, 34518, 34537, 34541, 34944, 35019*

34566 **(BNL—29776) Simple computer program to model 3-dimensional underground heat flow with realistic boundary conditions.** Metz, P.D. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 13p. (CONF-811101—11). NTIS, PC A02/MF A01. Order Number DE81030213.

From Winter annual meeting of the ASME Technology and Society Division; Washington, DC, USA (15 Nov 1981).

A FORTRAN computer program called GROCS (GRound Coupled Systems) has been developed to study 3-dimensional underground heat flow. Features include the use of up to 30 finite elements or blocks of earth which interact via finite difference heat flow equations and a subprogram which sets realistic time and depth dependent boundary conditions. No explicit consideration of moisture movement or freezing is given. GROCS has been used to model the thermal behavior of buried solar heat storage tanks (with and without insulation) and serpentine pipe fields for solar heat pump space conditioning systems. The program is available independently or in a form compatible with specially written TRNSYS component TYPE subroutines. The approach taken in the design of GROCS, the mathematics contained and the program architecture, are described. Then, the operation of the stand-alone version is explained. Finally, the validity of GROCS is discussed.

34567 **(CONF-801253—) Performance monitoring of solar domestic hot water systems.** Yarosh, M. (ed.). (Florida Solar Energy Center, Cape Canaveral (USA)). 1980. Contract FG01-80CS30544. 368p. NTIS, PC A16/MF A01.

From National workshop on performance monitoring of solar domestic hot water systems; Cape Canaveral, FL, USA (4 Dec 1980).

Thirteen papers are included. A separate abstract was prepared for each one. (MHR)

34568 (CONF-801253—, pp 6-18) **Solar hot water monitoring in Pennsylvania. Summary report III.** Aungst, W.K. (Pennsylvania State Univ., Middletown). 1980. NTIS, PC A16/MF A01.

From National workshop on performance monitoring of solar domestic hot water systems; Cape Canaveral, FL, USA (4 Dec 1980).

A monitoring program for approximately fifty solar domestic hot water systems in Pennsylvania uses relatively low cost instrumentation, which provides information which is collected by each individual homeowner. This data is then used to determine each systems performance. Results for about forty-eight sites have been obtained for time periods ranging from several months to over two years. These results have been used to: compare performance with f-chart predicted performance; compare performance of the different generic types of systems; obtain % solar, Btu/ft$^2$-day, Btu/ft$^2$-year, gallons/kw hr, gallons/day, and C.O.P. values for each site; compare performance of the different manufacturers systems; calculate estimated dollar savings and rates of return for each homeowner participant. Some of the background, objectives, and procedures used in the NESEC Monitoring Project are summarized.

**34569** (CONF-801253—, pp 19-39) **Solar energy and electricity are working together on Long Island.** Avril, F.P. (Long Island Lighting Co., Mineola, NY). 1980. NTIS, PC A16/MF A01.

From National workshop on performance monitoring of solar domestic hot water systems; Cape Canaveral, FL, USA (4 Dec 1980).

The LILCO Solar Demonstration Program specified a system which would meet the hot water needs of a typical family while combining solar energy with off-peak electricity as the backup. A system design by Solar Thermal Systems Division of Exxon Enterprises, Inc. was chosen and trademarked as the Solar Energymaster. This system is a drainback design with two collectors and a 120-gallon stone-lined storage tank. An important part of the program is the monthly seminars to instruct customers on ways to maximize the benefits of the system by using hot water efficiently. Also included is an explanation of the data from the hot water meter and off-peak electric meter which are necessary to assess the performance of the system. Over 60% of the customers in the program return hot water and off-peak electric consumption data on a monthly basis. These data are combined with assumptions of inlet water temperatures, tank stand-by losses and circulating pump consumption to calculate the average solar contribution of the Solar Energymaster system. The average annual solar contribution to date is 43.0%. Cost savings and pay-back periods versus conventional fuels are also calculated. At today's prices, the cost savings versus oil is 60% and the payback is less than 6 years, 54% and 7 years versus electricity and 31% and 14 years versus gas.

**34570** (CONF-801253—, pp 40-59) **Thermal performance monitoring of solar domestic hot water systems: needs, strategies, and pitfalls.** Thorsen, R.S. (Polytechnic Inst. of New York, Brooklyn). 1980. NTIS, PC A16/MF A01.

From National workshop on performance monitoring of solar domestic hot water systems; Cape Canaveral, FL, USA (4 Dec 1980).

The need for solar hot water system monitoring is discussed as it relates to the verification of thermal performance models and the establishmnet of actual thermal performance for in situ conditions for new systems. (MHR)

**34571** (CONF-801253—, pp 60-87) **Approach to quality control in a solar water heater performance monitoring program.** Kirkpatrick, D.L. (Sun Designs, Inc., Glen Moore, PA). 1980. NTIS, PC A16/MF A01.

From National workshop on performance monitoring of solar domestic hot water systems; Cape Canaveral, FL, USA (4 Dec 1980).

A residential water heating energy consumption monitoring project is being conducted by Atlantic City Electric Company (ACE) in their southern New Jersey service area. The water heating energy consumption of twenty-five families using two-tank solar-electric DHW systems is being measured in this two-year project. To provide comparative energy-use data, the conventional electric water heaters of twenty-five similar families are being measured concurrently.

**34572** (CONF-801253—, pp 88-115) **Testing and evaluation of Btu (heat) meters used for measuring solar systems performance.** Guinn, G.R.; Hummer, L.L. (Univ. of Alabama, Huntsville). 1980. NTIS, PC A16/MF A01.

From National workshop on performance monitoring of solar domestic hot water systems; Cape Canaveral, FL, USA (4 Dec 1980).

Approximately thirty-five Btu meters were systematically tested prior to installation in active solar DWH systems under evaluation. The results of these tests indicate the meter's capability to measure water volume and Btu's at flow rates typically found in solar systems. The operational experience and calibration results of three makes of meters being widely used as primary instrumentation on active solar energy systems are described.

**34573** (CONF-801253—, pp 116-142) **Description and application of the new Wilgood HM-2 series heat (Btu) meters with emphasis on solar energy domestic hot water systems.** Feller, M.F. (Wilgood Corp., Dunnellon, FL). 1980. NTIS, PC A16/MF A01.

From National workshop on performance monitoring of solar domestic hot water systems; Cape Canaveral, FL, USA (4 Dec 1980).

The design and capabilities of the HM-2 heat meter series are described. The application discussions are oriented towards solar energy with particular emphasis on solar energy heated domestic hot water. Flow and temperature sensing are given special consideration.

**34574** (CONF-801253—, pp 143-157) **Comparison of actual with predicted performance of 20 solar water heating systems in central Florida.** McCluney, R. (Florida Solar Energy Center, Cape Canaveral). 1980. NTIS, PC A16/MF A01.

From National workshop on performance monitoring of solar domestic hot water systems; Cape Canaveral, FL, USA (4 Dec 1980).

The results obtained from the field monitoring program are summarized and the predicted performance using F-chart is compared with the actual, measured performance of the 20 monitored systems. It was concluded that the best of the systems monitored were marginally cost effective.

**34575** (CONF-801253—, pp 158-174) **Proving solar pays.** Kraye, H. (Conserdyne Corp., Glendale, CA). 1980. NTIS, PC A16/MF A01.

From National workshop on performance monitoring of solar domestic hot water systems; Cape Canaveral, FL, USA (4 Dec 1980).

The reasons for full system in-field monitoring of solar systems as opposed to component laboratory testing are outlined. It is further shown how the proper publication and dissemination of this information can result in a significant increase in the quality, performance, cost effectiveness and public acceptance of solar energy. Results and details of various Conserdyne metering programs are presented along with selected summaries of both California and Department of Energy monitored system performance to show the state of the art in solar energy performance monitoring.

**34576** (CONF-801253—, pp 175-188) **Northern States Power Company's solar domestic hot water performance monitoring program.** Kasmarik, M.D. (Northern States Power Company, Minneapolis, MN). 1980. NTIS, PC A16/MF A01.

From National workshop on performance monitoring of solar domestic hot water systems; Cape Canaveral, FL, USA (4 Dec 1980).

The major feature of the Northern States Power (NSP) program is that the demonstration solar domestic water heating systems are being installed on NSP service center buildings. These service centers are combination garages, warehouses, and local offices for NSP's various divisions. The installation of these systems on NSP buildings allows a level of control and access to both the solar systems themselves, and the associated data retrieval equipment that would not be possible in residential environment. The data system designed by NSP for solar DWH system performance

monitoring, as well as methods utilized to report the retrieved data, are reported.

34577 (CONF-801253—, pp 189-211) **Comparative results of domestic hot water systems in the national solar data network.** Kelly, C.J. Jr. (Automation Industries, Inc., Silver Spring, MD). 1980. NTIS, PC A16/MF A01.

From National workshop on performance monitoring of solar domestic hot water systems; Cape Canaveral, FL, USA (4 Dec 1980).

Some summary results of monitoring of hot water installations are presented here. Fourteen sites were selected and performance factors presented for approximately 18 months of data. The location of these sites and pertinent physical data for each installation are shown.

34578 (CONF-801253—, pp 212-218) **Precision, resolution and accuracy of the Rho Sigma BTU meter.** Keegan, P.J. (Rho Sigma Corp., North Hollywood, CA). 1980. NTIS, PC A16/MF A01.

From National workshop on performance monitoring of solar domestic hot water systems; Cape Canaveral, FL, USA (4 Dec 1980).

The basic operation of the Rho Sigma BTU Meter is discussed so that the user can see what factors influence the precision, resolution, and accuracy of his measurements. This will enable the user of the instrument and to know in advance the range of errors to expect.

34579 (CONF-801253—, pp 7) **Solar energy in New Jersey-a utility evaluation.** Roman, H.T. 1980. NTIS, PC A16/MF A01.

From National workshop on performance monitoring of solar domestic hot water systems; Cape Canaveral, FL, USA (4 Dec 1980).

Two years of experience Public Service Electric and Gas (PSE & G) Research Corporation gained with the installation and testing of twelve contractor installed solar heating systems are summarized. PSE & G's desire to help develop a creditable solar industry within the State by offering solar water heaters to its customers is discussed also.

34580 (CONF-801253—, pp 17) **Commercial solar water heating systems operational test.** Guinn, G.R.; Hummer, L.; Novell, B.J. (Univ. of Alabama, Huntsville). 1980. NTIS, PC A16/MF A01.

From National workshop on performance monitoring of solar domestic hot water systems; Cape Canaveral, FL, USA (4 Dec 1980).

A demonstration of six commercially available water heaters has been erected by the Alabama Solar Energy Center for the purpose of developing public awareness of commercial technology and acquiring factual performance and operational data. The six systems are installed side-by-side on a typical roof structure and provide two examples each of silicone oil, antifreeze and drain-back freeze protection. Each system is instrumented with Btu and KWH meters to assess performance under an imposed load profile. The systems under evaluation, the instrumentation operational results acquired over a 15 month interval and performance over a 3 month interval are described.

34581 (CONF-810940—7) **Development of advanced building materials for the passive solar application.** Tomlinson, J.J. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE81032009.

From Annual contractors' review meeting on thermal and chemical storage; Tysons Corner, VA, USA (16 Sep 1981).

A program to develop the concept of incorporation of phase change materials (PCMs) into conventional building materials has been initiated and consists of in-house analyses to characterize the thermal performance of a porous matrix suffused with a PCM, and concept experimental development through subcontracted efforts as the result of an RFP. The program is directed toward the development of material concepts which provide greater collection/storage efficiency and increased levels of thermal comfort in direct gain passive solar applications.

34582 (CONF-7811183—) **Solar energy for livestock production: dairy, swine, poultry.** (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Agricultural Engineering). 1978. 218p. NTIS, PC A10/MF A01. Order Number DE81014880.

From Conference on solar energy for livestock production; College Park, MD, USA (28 Nov 1978).

Fourteen papers are included. A separate abstract was prepared for each one. (MHR)

34583 (CONF-7811183—, pp 15-25) **Use of solar energy in poultry production.** Reece, F.N. (Department of Agriculture, Mississippi State, MI). 1978. NTIS, PC A10/MF A01. Order Number DE81014880.

From Conference on solar energy for livestock production; College Park, MD, USA (28 Nov 1978).

A solar heating system has been designed, built, and tested which demonstrates that solar energy can reduce fossil-fuel requirements for heating broiler chicken houses in the Southeast US by about 90%. The general criteria for such a system are: total flat-plate collector area of 73 $ft^2$ per 1000 chickens; energy stored in water for use at night, with a storage capacity of 220 gallons per 1000 chickens; solar energy to be applied through the ventilation air; and energy conservation techniques such as adequate house insulation, precision ventilation control, and limited-area brooding must be used to reduce energy for heat in winter to the equivalent of 30 gallons of liquified petroleum gas (LPG) per 1000 chickens.

34584 (CONF-7811183—, pp 27-51) **Progress report on design and performance of solar heating systems for broiler houses.** Drury, L.N.; Mitchell, B.W.; Beard, C.W. (Department of Agriculture, Athens, GA). 1978. NTIS, PC A10/MF A01. Order Number DE81014880.

From Conference on solar energy for livestock production; College Park, MD, USA (28 Nov 1978).

The system has 16 35 $ft^2$ flat plate collectors and two 2000-gal water tanks for heat storage. The problems and operating experiences with seals, joints, leaks, etc., are reviewed. The particulars of the equipment, controls, and instrumentation design are reviewed. (MHR)

34585 (CONF-7811183—, pp 53-60) **Potential for conversion and utilization of solar energy in poultry production.** Brewer, R.N.; Flood, C.A. Jr.; Koon, J. (Auburn Univ., AL). 1978. NTIS, PC A10/MF A01. Order Number DE81014880.

From Conference on solar energy for livestock production; College Park, MD, USA (28 Nov 1978).

Research to date has been designed to test various systems of brooding chickens with emphasis on reducing total heat requirements. Partial house brooding was initiated as the first step in reducing heat requirements. Depending upon the time of year, chickens were brooded for 2 to 3 weeks at a bird density of .4 square foot per bird. After this period all birds were given .8 square feet. This system significantly reduces the amount of energy required during the early high energy requirement period. Five trials conducted during the 1977 to 1978 year are summarized. A combination of preheating ventilation air with solar energy and using forced air connection with the fin tubes is being compared with the system used during 1977 to 1978. To date, these changes have reduced the amount of auxiliary energy required by as much as 3 to 1.

34586 (CONF-7811183—, pp 61-77) **Solar energy utilization in poultry laying houses.** Esmay, M. (Michigan State Univ., East Lansing); Hall, F.; Flegal, C.; Zindel, H. 1978. NTIS, PC A10/MF A01. Order Number DE81014880.

From Conference on solar energy for livestock production; College Park, MD, USA (28 Nov 1978).

A low cost, flat plate, single air pass solar collector was constructed to provide supplemental heating for a 5000 bird poultry laying house in Michigan. The system was also used during the summer months to dry poultry excreta.

34587 (CONF-7811183—, pp 79-102) **Solar assisted turkey ventilation system.** Jordan, K.A.; Sokhansanj, S.; Weisbecker, T.L.; Johnson, V. 1978. NTIS, PC A10/MF A01. Order Number DE81014880.

From Conference on solar energy for livestock production; College Park, MD, USA (28 Nov 1978).

A hydronic system was designed for floor heating using plastic pipe embedded in the concrete to enhance vaporization of litter moisture as a means of lowering ventilation rates and thereby energy expenditures. The system uses 370 $ft^2$ of flat plate collectors. The thermal mass of the floor and a 500 gallon water tank are the heat storage. Experience gained with the system to date is reviewed. (MHR)

**34588** (CONF-7811183—, pp 103-112) **SOLSWINE: a user-oriented management tool for solar-assisted swine production facilities.** Schulte, D.D.; DeShazer, J.A.; Bodman, G.R.; Green, G. (Univ. of Nebraska, Lincoln). 1978. NTIS, PC A10/MF A01. Order Number DE81014880.

From Conference on solar energy for livestock production; College Park, MD, USA (28 Nov 1978).

A mathematical model (SOLSWINE) was developed for use in designing solar heating systems for swine production shelters. The model is limited to the investigation of the use of solar energy in modified open-front buildings. A discussion of the model and the results obtained from it are presented.

**34589** (CONF-7811183—, pp 113-119) **Solar heating of water for baby pig environmental control.** Meador, N.F. (Univ. of Missouri, Columbia); Eggerman, L.; McFate, K.L. 1978. NTIS, PC A10/MF A01. Order Number DE81014880.

From Conference on solar energy for livestock production; College Park, MD, USA (28 Nov 1978).

The system uses 50.24 $m^2$ of flat plate collectors and drain down freeze protection. Heat storage is in two 4.480 $m^3$ steel water tanks with 150 mm of urethane foam insulation. The cost of materials only is about $20 per square foot for the collection and storage system. (MHR)

**34590** (CONF-7811183—, pp 121-137) **Solar energy-intensifier with thermal energy storage.** Hellickson, M.A.; Verma, L.R.; Moe, D.L. (South Dakota State Univ., Brookings). 1978. NTIS, PC A10/MF A01. Order Number DE81014880.

From Conference on solar energy for livestock production; College Park, MD, USA (28 Nov 1978).

The solar energy-intensifier system was designed with a two-sided vertical collector and a parabolic trough reflector. The thermal energy storage unit is an insulated rock bin. The following are discussed: evaluation of the solar energy-intensifier system for drying shelled corn, evaluation of the solar energy-intensifier-thermal energy storage for space heating, and solar energy-intensifier performance with non-tracking and sun-tracking options. (MHR)

**34591** (CONF-7811183—, pp 139-155) **Performance of a solar-assisted heat pump with a thermal storage pond for heating livestock housing.** Vaughan, D.H.; Holmes, B.J.; Bell, E.S. (Virginia Polytechnic Inst. and State Univ., Blacksburg). 1978. NTIS, PC A10/MF A01. Order Number DE81014880.

From Conference on solar energy for livestock production; College Park, MD, USA (28 Nov 1978).

A heating system, using a solar assisted water-to-air heat pump and a thermal storage pond, was installed and used to heat a pig nursery during the winter of 1977 to 1978. The overall goal of this program was to develop a heating system which maximizes the use of solar heat, eliminates the need for direct-fired fuel heaters, and makes the most efficient use of electricity. For acceptance by swine producers in the United States, the system should be relatively simple to install, operate and maintain, and should be economically competitive with other commonly used heating systems. The performance of this solar assisted heat pump system for heating a pig nursery is discussed.

**34592** (CONF-7811183—, pp 157-173) **Solar energy for reducing fossil fuel usage in farrowing houses.** Spillman, C.K.; Robbins, F.V.; Hines, R.H. (Kansas State Univ., Manhattan). 1978. NTIS, PC A10/MF A01. Order Number DE81014880.

From Conference on solar energy for livestock production; College Park, MD, USA (28 Nov 1978).

The objective was to develop and demonstrate a system to use solar energy for heating ventilating air in a simple, economical way. The system developed is applicable to any building that requires both ventilation and heat during the winter. No sophisticated control system is needed on this collector because outside air must be admitted continuously, and any increase in temperature provides fuel savings as long as the building does not overheat. The system is intended to be used to supplement the conventional heater; it does not replace it. The main working part in this system is a massive, double glazed, vertical, south-facing concrete wall painted black through which the ventilating air is moved. The system could be used alternately to dry grain during the fall, and to cool summer ventilating air.

**34593** (CONF-7811183—, pp 175-185) **Material suitability and compatibility in the Beltsville Solar Energy System.** Hayden, M.B. (Dept. of Agriculture, Beltsville, MD). 1978. NTIS, PC A10/MF A01. Order Number DE81014880.

From Conference on solar energy for livestock production; College Park, MD, USA (28 Nov 1978).

A full scale solar heating system is now in operation at the USDA's milking parlor in Beltsville, MD. Proper application of current technology using easily available components and materials has been shown to significantly reduce energy demands upon conventional energy sources in the milking parlor, which is characterized by large and uniform energy expenditures. Roof mounted solar collector panels convert sunlight to thermal energy. Stored as temperature increase of water in an outside tank, this energy is utilized to preheat well water supplied to supplemental electric water heating, and to aid in space heating in the milking pit area via baseboard heaters. Additional energy is received from water warmed by the refrigeration condensers for the bulk milk tank cooling system. An extensive core of data has been accumulated on both system performance and on material durability. Specific investigations have involved the analysis of collector performance, system efficiency, material considerations, system optimization, assessment of heat extraction techniques, and system control. The importance of an integrated combination of solar energy utilization together with energy conservation and load reduction has been stressed as a solution to the escalating cost of conventional energy sources. The rewards of proper system management and design manifest themselves in increased system reliability and cost effectiveness.

**34594** (CONF-7811183—, pp 187-196) **Solar and heat recovery systems to heat water for dairies.** Wiersma, F.; Larson, D.L. (Univ. of Arizona, Tucson). 1978. NTIS, PC A10/MF A01. Order Number DE81014880.

From Conference on solar energy for livestock production; College Park, MD, USA (28 Nov 1978).

A study is being conducted to determine the amount of hot water currently used by dairies of different types and sizes. Dairies in five geographical locations identified as Northwest, Northeast, Southwest, Southeast and Central states are involved in measuring hot water use. In each region, dairies were categorized by size, to include a complete range, and by type (herringbone and sideopening). Water meters were installed on the line serving the water heating system. These meters are read by the dairymen who send in record of use at the end of each month. Over 100 dairies are equipped with meters for the study. Except for a couple of oil fired heaters, all water heaters in the study were either electric or gas. The temperature levels required for water in the milking operation are within or near the capabilities of solar energy systems with flat plate collectors. A small solar water heating system is currently under study at the Dairy Research Center of the University of Arizona in Tucson. This system provides about 20% of the capacity for heating water for the 130-cow dairy. The solar water heating system consists of two flat plate solar collectors, a 120-gallon insulated storage tank and piping to feed the water preheated by solar energy into a conventional gas heated water heater serving the milking parlor. The benefits of a heat recovery system are discussed.

34595 (CONF-7811183—, pp 197-221) **Solar energy use in a swine finishing unit.** Bodman, G.R.; DeShazer, J.A.; Moser, B.D. (Univ. of Nebraska, Lincoln). 1978. NTIS, PC A10/MF A01. Order Number DE81014880.

From Conference on solar energy for livestock production; College Park, MD, USA (28 Nov 1978).

The utilization of a floor-soil mass heat storage system can effectively reduce variations in temperature within the pig zone and provide more comfortable conditions for the pigs. Despite the lack of conclusive animal performance data to verify the benefits of the system, owner-operator satisfaction with the system has been very good. Both active and passive collectors do provide for increased temperature within the animal unit. However, where air ducts are utilized as part of the system, provisions must be made to control convective air currents and associated heat losses.

34596 **(DOE/CS/30375—T1) Passive design for a manufactured classroom building. Final report.** (Madison Industries, Inc., Conyers, GA (USA); Georgia Inst. of Tech., Atlanta (USA). School of Mechanical Engineering). 31 Mar 1981. Contract FC02-80CS30375. 88p. NTIS, PC A05/MF A01. Order Number DE81030496.

Work conducted by Madison Industries Inc. of Georgia and the Georgia Institute of Technology Engineering Experiment Station toward the development of passive solar heating systems for manufactured buildings is summarized. The specific application is a modular classroom building. Four passive system concepts were selected for space heating. These concepts are as follows: (1) direct gain; (2) water wall; (3) sunspace; and (4) integral collector wall. Designs were prepared for all four concepts. Thermal analyses were conducted, including annual heating simulations, for all designs. Typical weather and solar data for Atlanta were used in the simulations. In addition, design features for daylighting were incorporated in the building.

34597 (DOE/JPL—1060-46, pp 215-216) **Industrial application experiment series.** Bluhm, S.A. (Jet Propulsion Lab., Pasadena, CA). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

Two procurements within the Industrial Application Experiment Series of the JPL Thermal Power Systems Project are discussed. The first procurement, initiated in April 1980 has resulted in an award to the Applied Concepts Corporation for the Capitol Concrete Experiment: two Fresnel concentrating collectors will be evaluated in single-unit installations at the JPL Parabolic Dish Test Site and at Capitol Concrete Products, Topeka, Kansas. The second procurement will be initiated in March 1981 through the release of an RFP titled, Thermal System Engineering Experiment B. The objective of the new procurement is the rapid deployment of developed parabolic dish collectors. Two or more awards are intended. At least one award will be made to a team involving small business.

34598 (DOE/JPL—1060-46, pp 217-221) **Fresnel collector process heat experiment at Capitol Concrete Products.** Hauger, J.S. (Applied Concepts Corp., Reston, VA). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

Applied Concepts will plan, conduct and evaluate for JPL an experiment to determine the feasibility of using a Power Kinetics' Fresnel concentrator to provide process heat in an industrial environment. The system user will be Capitol Concrete Products of Topeka, Kansas. The plant will provide process steam at 50 to 60 psig to two autoclaves for curing masonry blocks. When steam is not required, the plant will preheat hot water for later use. A second system will be installed at the JPL parabolic dish test site for hardware validation and experment control. Both plants will be instrumented to provide technical performance data. Experiment design will allow for the extrapolation of results to varying demands for steam and hot water, and will include a consideration of some socio-technical factors such as the impact on production scheduling of diurnal variations in energy availability.

34599 (DOE/JPL—1060-46, pp 257-261) **Advanced development: fuels.** Ramohalli, K. (Jet Propulsion Lab., Pasadena, CA). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The solar thermal fuels and chemicals program at JPL is described. The primary objective is to develop and apply high technology to displace fossil fuel (oil) use in the production/processing of valuable fuels and chemicals: it is the aim to demonstrate the technical and economic feasibility to an extent that enables the industry to participate and commercialize the product. A representative process, namely Furfural production with a bottoming of acetone, butanol and ethanol (ABE), is described. Experimental data from all solar production of furfural is discussed. Estimates are given to show the attractiveness of this process especially considering its flexibility to be adaptable to dishes, troughs or central receivers. Peat, lignite and low rank coal processing, heavy oil stripping and innovative technologies for process diagnostics and control are mentioned as examples of current projects under intensive development.

34600 (DOE/JPL—1060-46, pp 275-282) **Solar energy water desalination in the United States and Saudi Arabia.** Luft, W.; Williamson, J. (Solar Energy Research Inst., Golden, CO). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

Plans for preliminary system design and cost analysis, detailed pilot plant design and construction, and pilot plant operation and training of personnel are discussed for the water desalination project. Two point-focus systems proposed are briefly described, and the project status is given. (LEW)

34601 **(EPRI-EM—1506-Vol.2) Solar heating and cooling of buildings (SHACOB): requirements definition and impact analysis-II. Volume 2. Domestic hot water systems.** Cretcher, C.K. (Aerospace Corp., El Segundo, CA (USA). Energy and Resources Div.). Nov 1980. 121p. NTIS, PC A06/MF A01. Order Number DE82900207.

The various types of solar DHW systems are discussed in detail including their advantages and disadvantages. A general review is provided of the problems that have occurred in hydronic solar heating systems, with emphasis on domestic hot water applications. System problems in retrofitting of residential buildings are also discussed including structural and space constraints for various components and subsystems. System design parameters are presented including various collector sizing methods, collector orientation, storage capacity and heat loss from pipes and tanks. The installation costs broken down by components and subsystems are presented. The approach used for the utility economic impact analysis is reviewed. The simulation is described, and the results of the economic impact analysis are given. Finally, a summary assessment is presented.

34602 **(LA-UR—81-2297) Summer-heat-gain control in passive-solar-heated buildings: fixed horizontal overhangs.** Jones, R.W. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-811109—2). NTIS, PC A02/MF A01. Order Number DE81028700.

From 1981 international passive and hybrid cooling conference; Miami Beach, FL, USA (11 Nov 1981).

An aspect of passive cooling relates to cooling load reduction by the use of solar controls. When there is a substantial winter heating requirement, and when the winter heating needs are met in part by a passive solar heating system, then the potential aggravation of summer cooling loads by the heating system is an important design issue. A traditional solution is the use of a fixed, horizontal shading overhang. An approach to quantitative design rules for the sizing of a shading overhang to minimize total annual space conditioning energy needs is outlined.

**34603 (LBL—12741) Energy conservation in Kenya: progress, potentials, problems.** Schipper, L.; Hollander, J.M.; Milukas, M.; Alcamo, J.; Meyers, S.; Noll, S. (Lawrence Berkeley Lab., CA (USA)). Sep 1981. Contract W-7405-ENG-48. 116p. NTIS, PC A06/MF A01. Order Number DE82000677.

A study was carried out of the flows of commercial energy in the economy of Kenya. Indications were sought of the extent to which energy conservation, (i.e., increase in efficiency of energy use) has reduced the ratio of energy inputs to economic outputs, in the post-1973 years. An assessment was made of the potential for energy conservation to reduce the growth of Kenyan energy use in the future and of significant barriers to increasing energy efficiency. Consideration was given to the role of government policy and of international assistance in fostering energy conservation in Kenya and other developing countries. The study was performed by analyzing available energy data and statistics from the largest oil companies, the Kenyan electric utility, and the government. These sources were supplemented by conducting personal interviews with personnel of nearly 50 commercial firms in Kenya. Direct consumption of fuel accounts for 94% of the commercial energy use in Kenya, while electricity accounts for 6%. The sectoral division of fuel use is: transportation 53%, industry 21%, energy production 11%, agriculture 9%, buildings and residences 5%, and construction 1%. For electricity the division is: buildings and residences 48%, industry 45%, energy production 4%, agriculture 2%, and construction 1%. Recent progress in conservation is reported.

**34604 (MASEC-H—81-041) Passive solar products catalog 1981.** Dotseth, M.M. (Mid-American Solar Energy Complex, Minneapolis, MN (USA)). 1981. Contract AC02-79CS30150. 362p. NTIS, PC A16/MF A01. Order Number DE82000292.

The Passive Solar Products Catalog was compiled through contacts with over 500 manufacturers and distributors across the country. The product listings are from manufacturers who responded to requests for information and the descriptions are based on information contained in the product literature. Only those products which can be marketed at this time are listed in the 1981 catalog. The catalog contains over 300 product listings. The catalog is organized according to product function and application including passive solar components and design resources and miscellaneous products. Manufacturer and product indexes are included as a cross reference in the back of the catalog. Distributors are not listed since most manufacturers prefer to have product inquiries initially directed to them.

**34605 (MASEC-PA—81-030) Passive-solar retrofit concepts.** (Mid-America Solar Energy Center, Minneapolis, MN (USA)). Sep 1981. Contract AC02-79CS30150. 49p. (P—102-4). NTIS, PC A03/MF A01. Order Number DE82000453.

Four retrofit passive solar designs for single-family dwellings are presented. The first design, for a house in Minnesota, involves insulating wall cavities and the attic with blown cellulose, reduction of infiltration, and installation of insulating shades on all windows. The second, for a house in Michigan, combines weatherization, a sunspace with clerestory, and a thermosiphoning collector. The third, for a house in Missouri, involves the addition of a large sunspace with a passive solar hot water preheater for a hot tub. The fourth, for a house in Indiana, combines intensive weatherization with a two-story sunspace and thermal chimney addition. All designs are thoroughly illustrated. (LEW)

**34606 (MASEC-PA—81-033) Passive-solar multi-family concepts.** (Mid-America Solar Energy Center, Minneapolis, MN (USA)). Aug 1981. Contract AC02-79CS30150. 88p. (P—103-2). NTIS, PC A05/MF A01. Order Number DE82000456.

Seven designs for passive solar apartment/townhouse buildings are presented. Each design is briefly described and thoroughly illustrated. The buildings are sited in Indiana, Michigan, Missouri, Ohio, South Dakota, and Minnesota. (LEW)

**34607 (MASEC/R—81-049) Cost data on renewable-program measures in the MASEC region.** Lupoli, J. (Mid-America Solar Energy Center, Minneapolis, MN (USA)). Aug 1981. Contract AC02-79CS30150. 90p. NTIS, PC A05/MF A01. Order Number DE82000293.

Material and installation costs were gathered for active solar domestic hot water systems. State-specific summaries were compiled into fact sheets. The original and updated solar domestic hot water cost data, including state-specific price ranges, the median, the impact of federal and state tax credits on system economics, the net cost to the homeowner, and the existence of additional state solar incentives are summarized. A regional profile is presented of 14 passive solar components, their product descriptions, functions, cost data, reasons for price variation, economy of scale, and a list of manufacturers contacted. (LEW)

**34608 (SAND—81-8232) Solar-central-receiver fuels and chemicals. Project status report, October 1980-June 1981.** Carling, R.W.; Fish, J.D.; Radosevich, L.G.; Vitko, J. Jr. (Sandia National Labs., Livermore, CA (USA)). Aug 1981. Contract AC04-76DP00789. 25p. NTIS, PC A02/MF A01. Order Number DE82000941.

Solar central receiver fuels and chemicals project activities at Sandia National Laboratories, Livermore, in the period October 1980 to June 1981 are described. During this time several fuels and chemicals processes were studied, and two processes were selected for further study: ethane pyrolysis and steam reforming of methane. The study criteria, status of ongoing work, and future activities are described.

**34609 (SERI/SP—722-342) Homeowner's solar-sizing workbook: a simplified method for sizing active solar space heating systems.** Bendt, P.; Soto, R. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1980. Contract AC02-77CH00178. 48p. NTIS, PC A03/MF A01. Order Number DE82000295.

The advantages of practicing home energy conservation are briefly explained, and active solar heating systems are described using liquid and air. A simplified sizing method based on the F-chart computer simulaton is described and illustrated with a sample worksheet. Guidelines for purchasing a system and selecting an installation contractor are given. (LEW)

**34610 (SERI/TP—631-1329) Simple predictive model for performance of desiccant beds for solar dehumidification.** Barlow, R.S. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1981. Contract AC02-77CH00178. 7p. (CONF-811109—1). NTIS, PC A02/MF A01. Order Number DE81023606.

From 1981 international passive and hybrid cooling conference; Miami Beach, FL, USA (11 Nov 1981).

A computer model is outlined for the absorption/desorption process that can be used to predict the performance of desiccant beds for solar regenerated dehumidification of passively cooled buildings. Instead of solving a set of coupled differential equations, the model uses simple algebraic equations for steady-state heat and mass exchangers. A comparison of computer predictions and experimental data demonstrate the validity and accuracy of the model. The physics of the adsorption process is discussed in terms of two psychrometric process lines, and planned research efforts at SERI are described.

**34611 Multi-staged retrofit of a greenhouse (a solar greenbed for agricultural applications with added passive solar walls).** Horak, P. (Fermi National Accelerator Lab., Batavia, IL). pp 15-22 of Proceedings of third annual energy seminar. Erie, PA; Gannon University (1981).

From 3. annual energy seminar; Erie, PA, USA (31 Mar 1981).

This paper describes a solar energy system that was originated to maximize collection of solar insolation in such a way as to reduce ambient greenhouse heating while increasing plant propogation within the constraints of limited project funds. The initial project, phase 1, introduced the use of active solar panels; it is now being followed by phase 2, combined passive and active solar collectors for ambient space and planting heat sources.

**34612 Solar domestic hot water testing fine tuning solar technology.** Nuhfer, T.R. pp 99-107 of Proceedings of third annual energy seminar. Erie, PA; Gannon University (1981).

From 3. annual energy seminar; Erie, PA, USA (31 Mar 1981).

A study to investigate a low cost instrumentation package and to determine design versus actual performance for residential solar assisted domestic hot water systems is reported. (LEW)

**34613 Modelling and monitoring solar thermal systems.** London, England; International Solar Energy Society (1980). 106p. (CONF-8010209—).

From Conference on modelling and monitoring solar thermal systems; London, UK (22 Oct 1980).

Eight papers are included. A separate abstract was prepared for each one. (MHR)

**34614 Nomogram for estimating the performance of solar hot water heaters.** Howarth, A.T. (UMIST, Manchester, England). pp 1-11 of Modelling and monitoring solar thermal systems. London, England; International Solar Energy Society (1980).

From Conference on modelling and monitoring solar thermal systems; London, UK (22 Oct 1980).

A method of predicting system performance by simplifying the analysis of energy balance in solar water heating systems operating over periods of several days duration is proposed. The approximations used inevitably lead to inaccuracies but the results do enable useful comparisons and economic assessments to be carried out quickly and cheaply. The method used also serves to clarify the important energy transfer processes involved and so understand the basis of more sophisticated prediction techniques. The influence of the major parameters points to the measurements to be taken in testing systems in use.

**34615 Mathematical modelling of active solar water and space heating systems.** Pye, D.B.; Rosenfeld, J.L.J. (Shell Research Ltd., Chester, England). pp 12-29 of Modelling and monitoring solar thermal systems. London, England; International Solar Energy Society (1980).

From Conference on modelling and monitoring solar thermal systems; London, UK (22 Oct 1980).

The evaluation of the cost-effectiveness of a domestic heating or cooling system is conveniently done in three phases: (1) the calculation of the heat fluxes into or out of the house and the heating and cooling loads these impose on the system, (2) the calculation of the system's response to the load and the energy required in various forms to operate the system, and (3) the calculation of the capital and running costs of the system. By splitting up the program in this way the individual parts are also useful in themselves. The first part can be used on its own to study the effectiveness of energy conservation measures. The second part can be used on its own to study system design, provided that a time series of loads is available. The use of these two programs is illustrated here, the first by reference to the house in Milton Keynes for which Laing's have designed the heating system, and the second by reference to the solar water heaters installed in Whateley Road, London, by the South London Consortium.

**34616 Monitoring of three tap and hybrid solar water heating systems at Whateley Road, London.** Makkar, L. (SLC Energy Group, London, England). pp 30-39 of Modelling and monitoring solar thermal systems. London, England; International Solar Energy Society (1980).

From Conference on modelling and monitoring solar thermal systems; London, UK (22 Oct 1980).

Solar Assisted Domestic Hot Water System installed in a terrace of 14 houses owned by the London Borough of Southwark, are evaluated. A brief outline of the Solar Systems is given first, followed by the description of the design and implementation of the monitoring system.

**34617 Monitoring of solar space heating and hot water systems at Milton Keynes.** Newton, G. (John Laing Research and Development Ltd., Hertfordshire, England). pp 40-53 of Modelling and monitoring solar thermal systems. London, England; International Solar Energy Society (1980).

From Conference on modelling and monitoring solar thermal systems; London, UK (22 Oct 1980).

Nine test houses at Milton Keynes are built in the form of a self-contained close and comprise 3 units with Laing low energy systems, 3 units with Calor Ltd systems, monitored separately by Calor Ltd and not described here and 3 units with basic gas air systems which act as control units. All have the same high insulation shell, large south facing windows and the same orientation. The experimental repetition rate is low and because the houses have been sold through a normal house agent there is an almost random selection of occupants. The Laing heating, ventilating and domestic hot water system is composed of a number of sub systems under a selective control system. The whole functioning as a single integrated unit. The internal conditions within each house are under the control of the occupier owners. Details of the monitoring and data acquisition systems are presented.

**34618 UK solar pilot test facility.** Potter, I.N. (Building Services Research and Information Association Bracknell, Berkshire, England). pp 54-72 of Modelling and monitoring solar thermal systems. London, England; International Solar Energy Society (1980).

From Conference on modelling and monitoring solar thermal systems; London, UK (22 Oct 1980).

The development, design, construction and initial trials of a laboratory facility for the validation of mathematical models and system studies of solar heating systems for houses are described. Eight member states of the Commission of the European Communities were to construct and operate Solar Pilot Test Facilities (PTF). The PTF's are facilities which can accommodate two or more separate solar domestic space heating systems which may also include a domestic hot water system. The collectors are subject to the prevailing weather conditions and are connected to a solar store with all necessary controls, etc. The load on the system is provided by a physical load simulator which is controlled by an on-line computer, programmed to simulate a house load interactive with the weather conditions and the thermal status of the solar storage. The load program also takes account of the supposed living habits of the occupants, thermal response of the house and its heating system. The design and construction of the two solar systems currently incorporated into the UK PTF are detailed. SS1 to the common design agreed by all participants which is a wet system using 47 $m^2$ flat plate collectors and having a 3 $m^3$ water storage and SS2, which is an air system using 19 $m^2$ of mesh type collectors and having a rock store with 4 $m^3$ volume of rock.

**34619 Comparison of physical and mathematical models of solar walls.** Lee, J.B.G.; Fitzgerald, D. (Leeds Univ., England). pp 84-93 of Modelling and monitoring solar thermal systems. London, England; International Solar Energy Society (1980).

From Conference on modelling and monitoring solar thermal systems; London, UK (22 Oct 1980).

The predictions of a finite difference computer model was compared with the measured performance of a solar wall designed using the model. The model was developed as part of an investigation into solar walls between 1976 and 1979. The design chosen allows heat recovery by forced convection through ducts within the wall, and treats the wall simply as an air heating element in a building. Direct heat transfer at the inside surface of the wall is made very small by insulation.

**34620 Monitoring solar walls in occupied houses.** Justin, B.; Guy, A.G.; Shaw, G. (Pilkington Brothers Ltd., Lancashire, England). pp 94-104 of Modelling and monitoring solar thermal systems. London, England; International Solar Energy Society (1980).

From Conference on modelling and monitoring solar thermal systems; London, UK (22 Oct 1980).

The monitoring of the thermal performance of 14 houses occupied by people in the age range of 60 years and over is described.

The site consists of 14 houses, 9 of which are insulated to a high level, e.g. in floor, walls, and ceiling and double glazing, and have a solar contribution to space heating from a double glazed solar wall. The remaining 5 houses are of the same plan form as the solar houses but do not have a solar wall and are insulated to 1976 building regulation standards. The plan layout of a typical house as represented by a solar house is shown.

## 1410 Solar Collectors And Concentrators

*REFER ALSO TO CITATION(S) 34493, 34494, 34495, 34537, 34927*

34621 (DOE/ET/20279—146) **Reducing conventive losses from cover glazings of solar-thermal collectors.** Raghuraman, P.; Kon, D. (Massachusetts Inst. of Tech., Lexington (USA)). 1981. Contract AC02-76ET20279. 8p. (CONF-811101—9). NTIS, PC A02/MF A01. Order Number DE81025726.

From Winter annual meeting of the ASME Technology and Society Division; Washington, DC, USA (15 Nov 1981).

Convective heat losses from cover glazings of solar thermal collectors are reduced by forming perpendicular crisscross rectangular grooves on the glazing which cause the air flow to form recirculating zones in the grooves. Experiments on the effects of varying groove geometry show that the cover-glazing convective heat-transfer coefficient can be reduced by a factor of four or better. Results of the experimental and analytical work and a description of the design considerations in optimizing the groove geometry are presented.

34622 (DOE/JPL—1060-46, pp 135-142) **Characterization of point focusing test bed concentrators at JPL.** Starkey, D.J. (Jet Propulsion Lab., Pasadena, CA). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The Solar Test Bed Concentrators are described that E-Systems installed at Edwards Air Force Base near Lancaster, California, for JPL. The characterization work is described that has been accomplished on the test units thus far and the test results are provided. The characterization data has been measured using both a flux mapper and a cold water calorimeter. The flux mapper uses a Kendall Radiometer as the sensing device. It is mounted on an x, y, z motor-driven positioning mechanism that allows the sensor to take an x-y flux raster at several Z planes in the vicinity of the concentrators nominal focal plane. Various concepts were tried to protect the concentrator structure from being damaged by the sun's energy during sun acquisition and deacquisition. A description of both the passive and active protective systems is presented.

34623 (DOE/JPL—1060-46, pp 143-147) **General Electric point focus solar concentrators status.** Zimmerman, J. (General Electric Co., Valley Forge, PA). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The General Electric Company is currently under contract to the Jet Propulsion Laboratory to design, fabricate, install and test a point focus solar concentrator that, given a high volume of production, will optimize the ratio of performance to cost. The concentrator design approach has evolved by a systemmatic process of examining the operating requirements particular to the solar application, minimizing material content through detail structural design and structurally efficient subsystem features, and utilizing materials and processes compatible with high volume production techniques. The design approach, the present concentrator configuration and the status of the hardware development are briefly described.

34624 (DOE/JPL—1060-46, pp 149-153) **Low cost concentrator.** Bedard, R.; Overly, P. (Acurex Corp., Mountain View, CA). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The Acurex Corporation is under contract to the Jet Propulsion Laboratory to design, fabricate, install, and test a cost-effective point focus solar concentrator. The key to concentrator cost effectiveness is the proper design of the reflector surface panels. The low cost concentrator reflective surface design is based on the use of a thin, backsilvered mirror glass reflector bonded to a molded structural plastic substrate. This combination of reflective panel material offers excellent optical performance at low cost. The design approach, rationale for the selected configuration, and the development status are briefly described. Reflective panel development and demonstration results are also presented.

34625 (DOE/JPL—1060-46, pp 155-159) **Advanced concentrator panels.** Bell, D.M.; Bedard, R.J. Jr. (Acurex Corp., Mountain View, CA). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

Acurex Corporation, under contract to the Jet Propulsion Laboratory (JPL), has completed the prototype fabrication of a lightweight, high-quality cellular glass substrate reflective panel for use in an advanced point-focusing solar concentrator. The reflective panel is a gore shaped segment of a 11-m paraboloidal dish. The overall concentrator design and the design of the reflective panels are briefly described. Prototype-specific panel design modifications are discussed and the fabrication approach and procedure outlined. The optical quality of the prototype panels appears to be excellent, although no quantitative results are yet available.

34626 (DOE/JPL—1060-46, pp 161-170) **Development and testing of the Shenandoah collector.** Kinoshita, G.S. (Sandia National Labs., Albuquerque, NM). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The test and development of the GE-designed 7-meter Shenandoah parabolic dish collector incorporating an FEK-244 film reflective surface and cavity receiver is described. Four prototypes tested in the Midtemperature Solar System Test Facility indicate, with changes incorporated from these development tests, that the improvements should lead to predicted performance levels in the production collectors.

34627 (DOE/JPL—1060-46, pp 171-178) **Fresnel concentrating collector.** Rogers, W.; Borton, D.; Rice, M.; Rogers, R. (Power Kinetics, Inc., Troy, NY). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The design and performance testing of a lightweight, simple Fresnel concentrating collector utilizing inexpensive materials are described. Two receiver designs were manufactured and tested. The first was a conically wound copper monotube boiler with 30° cone half angle, and the second was a steam unit heater employing steel tubes and fins. The fin tube boiler exhibited an average daily efficiency of 57%. The conical monotube boiler had an average daily efficiency of 68% and a peak efficiency of 79%. (LEW)

34628 (DOE/JPL—1060-46, pp 269-273) **Solar thermal materials research and development.** Gupta, B.P. (Solar Energy Research Inst., Golden, CO). 1 May 1981. NTIS, PC A14/MF A01. Order Number DE81028373.

In Parabolic-dish solar-thermal power: annual program review.

The research and development effort on optical and thermal materials is outlined, with the relative importance of different types of materials tabulated for different applications. (LEW)

34629 (PNL—3967) **Manufacturing and cost evaluation of second generation heliostats. Volume II. Appendices.** Drumheller, K.; Bondurant, P.D.; Brown, D.R.; Williams, T.A. (Battelle Pacific Northwest Labs., Richland, WA (USA); Pacific Northwest Lab., Richland, WA (USA)). Sep 1981. Contract AC06-76RL01830. 121p. NTIS, PC A06/MF A01. Order Number DE82000232.

Appendices are presented which give costs for five heliostats described in Vol. I. Contractor estimated costs are evaluated. Cost comparison sheets and a breakdown of contractor costs are included. (LEW)

34630 **(SAND—81-1180) User's guide to HELIOS: a computer program for modeling the optical behavior of reflecting solar concentrators. Part I. Introduction and code input.** Vittitoe, C.N.; Biggs, F. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1981. Contract AC04-76DP00789. 64p. NTIS, PC A04/MF A01. Order Number DE81031920.

HELIOS is a flexible computer code for evaluating designs for central-receiver, parabolic-dish, and other reflecting solar-energy collector systems, for safety calculations on the threat to personnel and to the facility itself, for determination of how various input parameters alter the power collected, for design trade-offs, and for heliostat evaluations. Input variables include atmospheric transmission effects, reflector shape and surface errors, suntracking errors, focusing and alignment strategies, receiver design, placement positions of the tower and mirrors, and time of day and day of the year for the calculation. Complete input instructions and a description of the code structure are given. The Code is in use at Sandia National Laboratories, Albuquerque (SNLA) on CDC 6600, CYBER 76, and CDC 7600 computers.

34631 **(SAND—81-8220) Evaluation of creep-fatigue life-prediction models for the solar central receiver.** Hyzak, J.M.; Hughes, D.A. (Sandia National Labs., Livermore, CA (USA)). Sep 1981. Contract AC04-76DP00789. 55p. NTIS, PC A04/MF A01. Order Number DE82000942.

The applicability of several creep-fatigue models to life prediction of the boiler tubes in a solar central receiver (SCR) is evaluated. The SCR boiler tubes will experience compressive strain dwell loading with hold times up to 6 to 8 hours at temperatures where time-dependent deformation will occur. Under these conditions compressive dwell cycles can be more damaging than tensile dwell cycles at small strain ranges. Thus, classical life prediction models generally developed from tensile dwell data may not be applicable to the SCR. The evaluation criteria include the ability of the model to account for mean stress effects and to be practical in the long life, small strain range regime. The review shows that most models including Linear Damage Summation may be nonconservative because mean stress effects are not included. A correlation between maximum tensile stress and fatigue life is presented which is common to both compressive dwell and continuous cycling tests. Using this correlation, compressive dwell behavior can be predicted based on more readily obtained continuous cycling data. The limits of this predictive scheme are addressed. Future predictive models based on crack propagation analysis are also discussed.

34632 **(SERI/TR—632-870) Near-term improvements in parabolic troughs: an economic and performance assessment.** Gee, R.; Murphy, L.M. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1981. Contract AC02-77CH00178. 54p. NTIS, PC A04/MF A01. Order Number DE82001158.

Improved parabolic-trough concentrating collectors will result from better design, improved fabrication techniques, and the development and utilization of improved materials. This analysis qualifies the performance potential of various parabolic-trough component improvements from a systems viewpoint and uses these performance data to determine the worth of each improvement on an economic basis. The improvements considered are evacuated receivers, silvered-glass reflectors, improved receiver, selective coatings, higher optical accuracy concentrations, and higher transmittance receiver glazings. Upper-bound costs for each improvement are provided as well as estimates of the increased solar system rates of return that are made possible by these improvements. The performance and economic potential of some of these improvements are shown to be substantial, especially at higher collector operating temperatures.

34633 **(SERI/TR—721-1161) Inexpensive thermographic techniques for determining reliable solar-collector-array performance.** Eden, A.; Haverty, T. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1981. Contract AC02-77CH00178. 35p. NTIS, PC A03/MF A01. Order Number DE82001151.

Thermographic equipment has been proven capable of detecting flow blockages, flow imbalances, and total array shutdown in residential and commercial solar energy collector systems. The research reported has determined the abilities of inexpensive thermographic equipment to perform solar array examinations in the field environment. SERI researchers found that less expensive instruments, in combinations to enhance the capabilities of each general type, can be used to examine solar collector arrays. Expert infrared equipment operators are not required to obtain some conclusions on system problems. A combination of spot radiation thermometers with either a hand-held imager or thermoprofile instrument is a viable inspection tool. Assessment of reliable flow control components, blocked collectors, unbalanced flow distribution, and reversed flow can all be observed with the combination of instruments. The user of the equipment must be thoroughly familiar with solar energy systems to most accurately interpret the indications. Time and effort spent assessing reliability and performance of solar collector arrays can be greatly decreased by use of these thermographic techniques and equipment.

34634 **Radiant energy receiver having improved coolant flow control means.** Hinterberger, H. (to Dept. of Energy). US Patent Application 201,958. 29 Oct 1980. 8p.

An improved coolant flow control for use in radiant energy receivers of the type having parallel flow paths is disclosed. A coolant performs as a temperature dependent valve means, increasing flow in the warmer flow paths of the receiver, and impeding flow in the cooler paths of the receiver. The coolant has a negative temperature coefficient of viscosity which is high enough such that only an insignificant flow through the receiver is experienced at the minimum operating temperature of the receiver, and such that a maximum flow is experienced at the maximum operating temperature of the receiver. The valving is accomplished by changes in viscosity of the coolant in response to the coolant being heated and cooled. No remotely operated valves, comparators or the like are needed.

34635 **Infrared detection--a tool for identifying malfunctioning elements in solar energy systems.** Sather, A. (Argonne Natl Lab, Ill). pp 235 of Paper summaries, national fall conference--american society for nondestructive testing: ndt for energy progress, 1980. Columbus, OH; American Society for Nondestructive Testing (1980).

From ASNT fall conference; Houston, TX, USA (6 Oct 1980).

The present report describes the use of infrared detection to locate malfunctioning elements in a Sunmaster liquid collector array under evaluation at Florida State Solar Energy Center (FSEC). The performance of the system suggested thermal losses beyond expectations, based on experience with Owens Illinois vacuum collector tubes and prototype collector manifold insulation. The suspected areas were evacuated tubes, the connector between the two modules, and the glass-to-copper interfaces between the upper and lower manifold both covered by formed polyurethane insulation. The temperatures of the evacuated tubes were compared, intermodular connections were examined for heat leaks, and the effectiveness of the insulation was evaluated in one quick, easy operation: Hot water was circulated through the array until a stable temperature was reached, and the array was then scanned with an infrared camera.

34636 **Physical modelling of air-heating collectors.** Yaneske, P.P.; Wiles, I.C. (Univ., of Strathclyde, Glasgow, England). pp 73-83 of Modelling and monitoring solar thermal systems. London, England; International Solar Energy Society (1980).

From Conference on modelling and monitoring solar thermal systems; London, UK (22 Oct 1980).

In order to optimise the design of an air-heating collector, it is important to be able to accurately model the transfer of heat within the collector. It is also necessary to consider pressure losses for flow through the collector in order to predict fan power, since the power required to pass air through a collector is proportional to the pressure drop across it. The nature and modelling of the thermal and frictional characteristics of two major types of air-heating collector, the rear duct collector and the porous absorber collector, are discussed.

## 1420 Heat Storage

*REFER ALSO TO CITATION(S) 34581*

**34637 (DOE/CS/35101—T1) Research on solar-energy-storage subsystems utilizing the latent heat of phase change of certain organic materials. Final report.** Bailey, J.A.; Mulligan, J.C.; Liao, C.K. (North Carolina State Univ., Raleigh (USA). Dept. of Mechanical and Aerospace Engineering). [nd]. Contract AS05-76CS35101. 211p. NTIS, PC A10/MF A01. Order Number DE81030688.

A survey of petroleum product manufacturers was conducted and a number of inexpensive organic materials of potential value for phase-change thermal energy storage were identified. Sunoco wax number 3420 was chosen for further work because of its desirable properties and low cost. An analytic procedure was formulated for modelling thermal capacitors whose intrastructure encapsulate the phase change material. Three such thermal capacitors were constructed and tested to validate the analytic procedure. (LEW)

# 15 GEOTHERMAL ENERGY

## 1501 Resource Status And Assessment

**34638 (LBL—12961) Program planner's guide to geothermal development in California.** Yen, W.W.S.; Chambers, D.M.; Elliott, J.F.; Whittier, J.P.; Schnoor, J.J.; Blachman, S. (Lawrence Berkeley Lab., CA (USA)). 30 Sep 1980. Contract W-7405-ENG-48. 314p. NTIS, PC A14/MF A01. Order Number DE82000700.

The resource base, status of geothermal development activities, and the state's energy flow are summarized. The present and projected geothermal share of the energy market is discussed. The public and private sector initiatives supporting geothermal development in California are described. These include legislation to provide economic incentives, streamline regulation, and provide planning assistance to local communities. Private sector investment, research, and development activities are also described. The appendices provide a ready reference of financial incentives. (MHR)

**34639** (WAOENG—80-16, pp XIII.1-XIII.4) **Utility perspectives on northwest geothermal resources.** Johnson, V.V. (Washington Public Power Supply System, Richland, WA). Sep 1980. NTIS, PC A07/MF A01. Order Number DE81023998.

From Geothermal symposium: potential, legal issues, economics, financing; Seattle, WA, USA (2 Jun 1980).

Three major activities involved in a coordinated development program are reviewed: hardware and technology development, institutional and regulatory process and procedures, and resource assessment and development. (MHR)

## 1502 Geology And Hydrology Of Geothermal Systems

*REFER ALSO TO CITATION(S) 34644*

**34640 (IDO—10098) Case studies of low-to-moderate temperature hydrothermal energy development.** (EG and G Idaho, Inc., Idaho Falls (USA); Lawrence Berkeley Lab., CA (USA)). Oct 1981. Contract AC07-76ID01570. 126p. NTIS, PC A07/MF A01. Order Number DE82000883.

Six development projects are examined that use low- [less than 90°C (194°F)] to-moderate [90 to 150°C (194 to 302°F)] temperature geothermal resources. These projects were selected from 22 government cost-shared projects to illustrate the many facets of hydrothermal development. The case studies describe the history of this development, its exploratory methods, and its resource definition, as well as address legal, environmental, and institutional constraints. A critique of procedures used in the development is also provided and recommendations for similar future hydrothermal projects are suggested.

## 1503 Geothermal Exploration And Exploration Technology

**34641 (DOE/ET/27012—1) Geothermal reservoir assessment: Northern Basin and Range Province, Stillwater prospect, Churchill County, Nevada. Final report, April 1979-July 1981.** Ash, D.L.; Dondanville, R.F.; Gulati, M.S. (Union Oil Co. of California, Los Angeles (USA)). Aug 1981. Contract AC08-79ET27012. 35p. NTIS, PC A03/MF A01. Order Number DE82000529.

Union Oil Company of California drilled two exploratory geothermal wells in the Stillwater geothermal prospect area in northwestern Nevada to obtain new subsurface data for inclusion in the geothermal reservoir assessment program. Existing data from prior investigations, which included the drilling of four earlier deep temperature gradient wells in the Stillwater area, was also provided. The two wells were drilled to total depths of 6946 ft and 10,014 ft with no significant drilling problems. A maximum reservoir temperature of 353°F was measured at 9950 ft. The most productive well flow tested at a rate of 152,000 lbs/hr with a wellhead temperature of 252°F and pressure of 20 psig. Based upon current economics, the Stillwater geothermal prospect is considered to be subcommercial for the generation of electrical power. This synopsis of the exploratory drilling activities and results contains summary drilling, geologic, and reservoir information from two exploratory geothermal wells.

**34642 (DOE/ET/28384—T1) Formation evaluation in liquid-dominated geothermal reservoirs.** Ershaghi, I.; Dougherty, E.E.; Handy, L.L. (University of Southern California, Los Angeles (USA). Dept. of Petroleum Engineering). Apr 1981. Contract AT03-76ET28384. 106p. NTIS, PC A06/MF A01.

Studies relative to some formation evaluation aspects of geothermal reservoirs are reported. The particular reservoirs considered were the liquid dominated type with a lithology of the sedimentary nature. Specific problems of interest included the resistivity behavior of brines and rocks at elevated temperatures and studies on the feasibility of using the well log resistivity data to obtain estimates of reservoir permeability. Several papers summarizing the results of these studies were presented at various technical meetings for rapid dissemination of the results to potential users. These papers together with a summary of data most recently generated are included. A brief review of the research findings precedes the technical papers. Separate abstracts were prepared for four papers. Five papers were abstracted previously for EDB.

**34643 (DOE/ET/37035—T1) Resource assessment of low- and moderate-temperature geothermal waters in Calistoga, Napa County, California. Report of the second year, 1979-1980.** Youngs, L.G.; Bacon, C.F.; Chapman, R.H.; Chase, G.W.; Higgins, C.T.; Majmundar, H.H.; Taylor, G.C. (California State Dept. of Conservation, Sacramento (USA). Div. of Mines and Geology ). 10 Nov 1980. Contract FG03-79ET37035. 394p. NTIS, PC A17/MF A01. Order Number DE81025559.

Phase I studies included updating and completing the USGS GEOTHERM file for California and compiling all data needed for a California Geothermal Resources Map. Phase II studies included a program to assess the geothermal resource at Calistoga, Napa County, California. The Calistoga effort was comprised of a series of studies involving different disciplines, including geologic, hydrologic, geochemical and geophysical studies.

**34644 (DOE/ET/37035—T2) Geophysical survey, Paso Robles geothermal area, California, part of the resource assessment of low- and moderate-temperature geothermal resource areas in California.** Chapman, R.H.; Chase, G.W.; Youngs, L.G. (California State Dept. of Conservation, Sacramento (USA). Div. of Mines and Geology ). 10 Nov 1980. Contract FG03-79ET37035. 42p. NTIS, PC A03/MF A01. Order Number DE81026038.

Some general background information concerning the geology and geothermal occurrences in the Southern Coast Ranges is included, as well as the more detailed information dealing with the Paso Robles area proper. Results for two geophysical methods that

have been used in the area: the ground magnetic and gravity surveys, are discussed and interpreted.

**34645** (WAOENG—80-16, pp III.1-III.5) **Washington State geothermal resources assessment program.** Schuster, J.E.; Korosec, M.A. (Washington State Dept. of Natural Resources, Olympia). Sep 1980. NTIS, PC A07/MF A01. Order Number DE81023998.

From Geothermal symposium: potential, legal issues, economics, financing; Seattle, WA, USA (2 Jun 1980).

Assessment activities have thus far been in temperature-gradient and heat-flow investigations, geochemical investigation of mineral and thermal springs, evaluation of low-temperature geothermal resources in the Yakima area, geologic mapping, a resistivity survey, regional gravity measurements, analysis of geologic lineaments, and preparation of geothermal resource maps for Washington State. Attention was focused on the southwestern Cascades during 1979. During 1980, the focus has shifted to the southeastern Cascades and southwestern Columbia Basin, where preliminary temperature-gradient data seem to indicate good prospects for the occurrence of direct-use geothermal resources.

**34646** (WAOENG—80-16, pp IV.1-IV.7) **Geothermal potential in Washington.** Vice, D.H. (Burlington Northern, WA). Sep 1980. NTIS, PC A07/MF A01. Order Number DE81023998.

From Geothermal symposium: potential, legal issues, economics, financing; Seattle, WA, USA (2 Jun 1980).

This geothermal exploration program has concentrated on Burlington Northern owned and adjacent lands in Washington and western Montana. The purpose of the program has been to evaluate the geothermal resource potential of the company lands for effective land management practices. This resource information is also needed to protect the company's interests in land exchanges. The BN exploration program has concentrated on preliminary reconnaissance surveys in areas with some surface manifestation, such as a thermal spring (i.e., hot spring, warm spring or mineral spring), hot spring deposit (either tufa or siliceous sinter), or areas of recent volcanic activity. These surveys would involve locating and collecting water samples from the thermal springs, making notes on the geology of the spring area or spring deposit, taking rock and soil samples from the spring deposits, and studying the vegetative patterns in the immediate area. The water samples are analyzed for major ions and certain selected indicator ions such as boron, fluoride, lithium, and silica. This geochemical data is used to estimate the subsurface reservoir temperature and to get an indication of whether the geothermal system is a hot-water or steam type. If the geochemical data is favorable, then thermal Infrared surveys are flown over a large area surrounding the surface manifestation. The data is prepared in mosaic form and then analyzed. These thermal ir ground anomalies can be confirmed by soil temperature surveys.

**34647** (WAOENG—80-16, pp IX.1-IX.9) **Federal cost-sharing for exploration of hydrothermal reservoirs for direct applications: user-coupled confirmation drilling program.** Wright, M. (Univ. of Utah, Salt Lake City). Sep 1980. NTIS, PC A07/MF A01. Order Number DE81023998.

From Geothermal symposium: potential, legal issues, economics, financing; Seattle, WA, USA (2 Jun 1980).

The US Department of Energy (DOE) will share the cost of the exploration, well-siting, drilling, flow testing, reservoir engineering, and, if necessary, injection well drilling to confirm the desired temperature and flow rate of a hydrothermal reservoir to be used for direct heat application. If a reservoir with an optimum temperature and flow rate is confirmed, the DOE cost-share will be 20 percent. If the project is completely unsuccessful, the DOE cost-share will be 90 percent. An example of the federal percentage of cost-sharing for a selected confirmation project is shown as the cost share ranges between these extremes.

## 1504 Legal And Institutional Aspects

*REFER ALSO TO CITATION(S) 34647, 34652, 34666*

**34648** (WAOENG—80-16, pp VII.1-VII.14) **Geothermal legislative policy concerns.** Wonstolen, K. (National Conference of State Legislatures, Denver, CO). Sep 1980. NTIS, PC A07/MF A01. Order Number DE81023998.

From Geothermal symposium: potential, legal issues, economics, financing; Seattle, WA, USA (2 Jun 1980).

The following are discussed: characterization and ownership, access and allocation, regulatory procedures, and finance and marketing.

**34649** (WAOENG—80-16, pp VIII.1-VIII.6) **Synopsis of the federal geothermal program.** Short, B. (Bureau of Land Management, Washington, DC). Sep 1980. NTIS, PC A07/MF A01. Order Number DE81023998.

From Geothermal symposium: potential, legal issues, economics, financing; Seattle, WA, USA (2 Jun 1980).

The basic qesponsibilities for the Federal Geothermal Program as divided between the Department of Energy, Interior, and Agriculture are described. (MHR)

**34650** (WAOENG—80-16, pp XV.1-XV.6) **State public utility regulation of geothermal direct heat suppliers.** Nimmons, J.T. (Univ. of California, Berkeley). Sep 1980. NTIS, PC A07/MF A01. Order Number DE81023998.

From Geothermal symposium: potential, legal issues, economics, financing; Seattle, WA, USA (2 Jun 1980).

The implications of public utility regulation often have been considered in the context of geothermal electric generation, where existing utilities have been among the central actors. The prospect of public utility status for direct heat projects, in which most major utilities so far have shown little interest, has received far less attention. That prospect, and its regulatory implications, will be of increasing concern to direct heat suppliers, district heating developers and process heat users wishing to recoup their costs through sales of excess fluids. That concern is addressed based upon an analysis of existing public utility law in 16 western states. Regulatory schemes vary among the states studied, but most would reach suppliers providing hot water or steam to any significant portion of the general public. Some states would exempt publicly-owned utilities, certain non-profit corporations or cooperatives, small-scale water systems, or surplus sales. Geothermal suppliers defined as public utilities and not otherwise exempt will typically be subject to utility commission control of territorial limits, accounting practices, financing options, and rates. To the extent that traditional rate-setting practices fail to account for the cost of risks associated with resource exploration, regulation may create significant disincentives to development.

**34651** **(WAOENG—80-16) Proceedings of the geothermal symposium: potential, legal issues, economics, financing.** Bloomquist, R.G. (ed.). (Washington State Government, Olympia (USA)). 2 Jun 1980. Contract FG51-79R000079. 134p. (CONF-8006173—). NTIS, PC A07/MF A01. Order Number DE81023998.

From Geothermal symposium: potential, legal issues, economics, financing; Seattle, WA, USA (2 Jun 1980).

Fourteen papers are included. A separate abstract was prepared for each one. (MHR)

## 1505 Economic And Financial Aspects

*REFER ALSO TO CITATION(S) 34647, 34648, 34651, 34656*

**34652** (WAOENG—80-16, pp X.1-X.7) **Geothermal loan guaranty program.** Bromberg, K.M. (Dept. of Energy, Oakland, CA). Sep 1980. NTIS, PC A07/MF A01. Order Number DE81023998.

From Geothermal symposium: potential, legal issues, economics, financing; Seattle, WA, USA (2 Jun 1980).

The program objectives, uses, and the application evaluation process are reviewed. Four loan projects and the future direction of the program are described (MHR)

34653 (WAOENG—80-16, pp XII.1-XII.5) **Financing of geothermal projects.** Woods, J.H. (Bank of Montreal, San Francisco, CA). Sep 1980. NTIS, PC A07/MF A01. Order Number DE81023998.

From Geothermal symposium: potential, legal issues, economics, financing; Seattle, WA, USA (2 Jun 1980).

The banker's viewpoint in geothermal financing and the steps in the loan procedure are presented. The effect of the Geothermal Loan Guarantee Program is explored. (MHR)

## 1506 Environmental Aspects And Waste Disposal

34654 **(EPRI-ER—896) Experimental investigation of the removal of hydrogen sulfide from geothermal steam.** Schwab, J.; Goodson, D.; Milovsoroff, P. (Air Pollution Systems, Inc., Kent, WA (USA)). Sep 1978. 19p. NTIS, PC A02/MF A01. Order Number DE82900063.

A technique for applying hi-intensity corona energy to a synthesized geothermal $H_2S$/steam gas was tested. Mass spectrographic analysis showed no removal of $H_2S$ with steam due to difficulty in obtaining stable operating parameters. Conversion in laboratory air and compressed gas at attractive conversion efficiencies, however, was observed. Recommendations for reactor design changes such that stable power input may be obtained are recommended.

## 1508 Geothermal Power Plants

*REFER ALSO TO CITATION(S) 34664, 34665*

34655 (WAOENG—80-16, pp VI.1-VI.6) **Assessment of geothermal energy as a power source for US aluminum reduction plants.** Davis, A.E.; Enderlin, W.I.; Blahnik, D.E.; Jacobson, J.J.; Weakley, S.A. (Pacific Northwest Lab., Richland, WA). Sep 1980. NTIS, PC A07/MF A01. Order Number DE81023998.

From Geothermal symposium: potential, legal issues, economics, financing; Seattle, WA, USA (2 Jun 1980).

The technical and economic feasibility of using geothermal resources as a primary power source for US aluminum reduction plants is assessed. The principal objective is to explore the potential for providing geothermally generated electric power to existing smelters in the Pacific Northwest. Also evaluated are the possibilities of supplying existing smelters in the Gulf Coast area, as well as supplying new smelters located at or near a geothermal resource. While not conclusive, the study results strongly suggest it is both technically and economically feasible to power an existing smelter in the Northwest using electricity generated at Roosevelt Hot Springs, Utah. It was concluded, therefore, that detailed, site-specific feasibility studies are justified and should be undertaken. Further, it was concluded that it would not be feasible to operate either existing Gulf Coast smelters or newly constructed smelters using geothermal electric power.

34656 (WAOENG—80-16, pp XI.1-XI.19) **Geothermal power plant economics.** Hankin, J.W. (Bechtel National, Inc., San Francisco, CA). Sep 1980. NTIS, PC A07/MF A01. Order Number DE81023998.

From Geothermal symposium: potential, legal issues, economics, financing; Seattle, WA, USA (2 Jun 1980).

An overview of the various types of geothermal power plants, their applicability to the different classes of geothermal resources, and the factors that affect the economics of generating electric energy from geothermal resources is presented. It is concluded that electric energy produced by geothermal power plants operating from steam resources, and from brine resources with temperatures of about 350°F or higher, is economically competitive today with that produced by conventional power plants.

## 1509 Geothermal Engineering

*REFER ALSO TO CITATION(S) 34640, 34641*

34657 (DOE/ET/28384—T1, pp 84-90) **Improved method for measurement of filtration properties of drilling fluids.** Mehdizadeh, A.; Ershaghi, I. Apr 1981. NTIS, PC A06/MF A01.

In Formation evaluation in liquid-dominated geothermal reservoirs.

During drilling operation by the rotary method, drilling mud is filtered against permeable beds. Mud filtrate invades the formation to a certain distance depending on properties of the formation and the pressure differential against the formation. Prediction of filtration properties of a given mud under downhole conditions is an important part of an overall plan in minimizing damage to producing formations. Because of the need for some actual dynamic filtration test data for use in mathematical modeling, the API cell was modified and a portable unit constructed which can provide improved estimates of filter loss data. The design is described and some typical dynamic filtration measurement are presented.

34658 **(LA-UR—81-2529) Drilling fluids and lost circulation in hot-dry-rock geothermal wells at Fenton Hill.** Nuckols, E.B.; Miles, D.; Laney, R.; Polk, G.; Friddle, H.; Simpson, G. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 11p. (CONF-811015—15). NTIS, PC A02/MF A01. Order Number DE81030137.

From Geothermal Resources Council annual meeting; Houston, TX, USA (25 Oct 1981).

Geothermal hot dry rock drilling at Fenton Hill in northern New Mexico encountered problems of catastrophic lost circulation in cavernous areas of limestones in the Sandia Formation, severe corrosion due to temperatures of up to 320°C, and torque problems caused by 35° hole angle and the abrasiveness of Precambrian crystalline rock. The use of polymeric flocculated bentonite fluid, clear water, fibrous material, dry drilling, oxygen scavengers, a biodegradable lubricant mixture of modified triglicerides and alcohol, and maintenance of a high pH, were some of the approaches taken toward solving these problems.

34659 **(PNL—3592) Development of the high-temperature redox electrode and improved corrosion rate meter. Interim report for period ending September 1980.** Danielson, M.J.; Koski, O.H. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1981. Contract AC06-76RL01830. 38p. NTIS, PC A03/MF A01. Order Number DE82000933.

The oxidation-reduction (redox) electrode studies at Pacific Northwest Laboratory (PNL) were completed with the examination of the sulfide-sulfate system. This system is extremely reducing, and it was concluded that the redox electrode would still respond to the entry of oxygen even though sulfide is an oxygen getter. The corrosion rate of platinum in oxygenated brine was determined at 250°C. It was concluded that the mechanism of response to oxygen fits a mixed potential model. Work began on the improved corrosion rate meter (ICR). A potentiostat and programmer were constructed and successfully tested. Corrosion tests were carried out in 25°C brine with and without oxygen, and the ICR response was very good when compared to corrosion rates determined by weight loss. Future work will involve autoclave tests and development of microprocessor control of the electronics to simplify the measurements.

34660 **(SAND—81-7126) Feasibility study of tuned-resonator, pulsating cavitating water jet for deep-hole drilling.** Johnson, V.E. Jr.; Lindenmuth, W.T.; Conn, A.F.; Frederick, G.S. (Sandia National Labs., Albuquerque, NM (USA); Hydronautics, Inc., Laurel, MD (USA)). Aug 1981. Contract AC04-76DP00789. 142p. NTIS, PC A07/MF A01. Order Number DE81031924.

This study presents the advantages of pulsing a submerged jet to increase its erosion capability (particularly as caused by cavitation) in augmenting deep-hole drill bits. Various methods of accomplishing the pulsation are presented and discussed. The most attractive systems uncovered are acoustic oscillators which passively accomplish pulsations in the flow at frequencies corresponding to a

Strouhal number in the range of 0.2 to 1.0. Such passive oscillators are assessed to be feasible candidates for development into practical deep hole drill bit systems and a long range plan for this research and development is presented and discussed.

34661 **(SAND—81-7129) Lost circulation in geothermal wells: survey and evaluation of industry experience.** Goodman, M.A. (Enertech Engineering and Research Co., Houston, TX (USA)). Jul 1981. Contract AC04-76DP00789. 44p. NTIS, PC A03/MF A01. Order Number DE81029960.

Lost circulation during drilling and completion of geothermal wells can be a severe problem, particularly in naturally fractured and/or vugular formations. Geothermal and petroleum operators, drilling service companies, and independent consultants were interviewed to assess the lost circulation problem in geothermal wells and to determine general practices for preventing lost circulation. This report documents the results and conclusions from the interviews and presents recommendations for needed research. In addition, a survey was also made of the lost circulation literature, of currently available lost circulation materials, and of existing lost circulation test equipment.

34662 **(SAND—81-7130) Balanced pressure techniques applied to geothermal drilling.** Dareing, D.W. (Sandia Labs., Albuquerque, NM (USA); Maurer Engineering, Inc., Houston, TX (USA)). Aug 1981. Contract AC04-76DP00789. 98p. NTIS, PC A05/MF A01. Order Number DE81030215.

The objective of the study is to evaluate balanced pressure drilling techniques for use in combating lost circulation in geothermal drilling. Drilling techniques evaluated are: aerated drilling mud, parasite tubing, concentric drill pipe, jet sub, and low density fluids. Based on the present state of the art of balanced pressure drilling techniques, drilling with aerated water has the best overall balance of performance, risk, availability, and cost. Aerated water with a 19:1 free air/water ratio reduce maximum pressure unbalance between wellbore and formation pressures from 1000 psi to 50 psi. This pressure unbalance is within acceptable operating limits; however, air pockets could form and cause pressure surges in the mud system due to high percent of air. Low density fluids used with parasite tubing has the greatest potential for combating lost circulation in geothermal drilling, when performance only is considered. The top portion of the hole would be aerated through the parasite tube at a 10:1 free air/mud ratio and the low density mud could be designed so that its pressure gradient exactly matches the formation pore pressure gradient. The main problem with this system at present is the high cost of ceramic beads needed to produce low density muds.

### 1510 Direct Energy Utilization

*REFER ALSO TO CITATION(S) 34520, 34640, 34650*

34663 **(DOE/SF/11442—T2) Feasibility of geothermal heat use in the San Bernardino Municipal Wastewater Treatment Plant. Final report, September 1980-June 1981.** Racine, W.C.; Larson, T.C.; Stewart, C.A.; Wessel, H.B. (San Bernardino Municipal Water Dept., CA (USA); Science Applications, Inc., La Jolla, CA (USA); Stewart (Coulter) and Associates, Inc., Davis, CA (USA)). 1981. Contract FG03-80SF11442. 115p. NTIS, PC A06/MF A01. Order Number DE81030968.

A system was developed for utilizing nearby low temperature geothermal energy to heat two high-rate primary anaerobic digesters at the San Bernardino Wastewater Treatment Plant. The geothermal fluid would replace the methane currently burned to fuel the digesters. A summary of the work accomplished on the feasibility study is presented. The design and operation of the facility are examined and potentially viable applications selected for additional study. Results of these investigations and system descriptions and equipment specifications for utilizing geothermal energy in the selected processes are presented. The economic analyses conducted on the six engineering design cases are discussed. The environmental setting of the project and an analysis of the environmental impacts that will result from construction and operation of the geothermal heating system are discussed. A Resource Development Plan describes the steps that the San Bernardino Municipal Water Department could follow in order to utilize the resource. A preliminary well program and rough cost estimates for the production and injection wells also are included. The Water Department is provided with a program and schedule for implementing a geothermal system to serve the wastewater treatment plant. Regulatory, financial, and legal issues that will impact the project are presented in the Appendix. An outline of a Public Awareness Program is included.

34664 **(WAOENG—80-16, pp II.1-II.12) Geothermal resource utilization.** Lienau, P.J. (Oregon Inst. of Technology, Klamath Falls). Sep 1980. NTIS, PC A07/MF A01. Order Number DE81023998.

From Geothermal symposium: potential, legal issues, economics, financing; Seattle, WA, USA (2 Jun 1980).

Examples of use of geothermal resources are reviewed including: space conditioning, agriculture and aquaculture, industrial processes, and electrical generation. Diagrams are included for the following: dry steam power plant, flash steam power plant, double flash power plant, and binary cycle power plant. An electrical generation cost comparison is tabulated. (MHR)

34665 **(WAOENG—80-16, pp V.1-V.5) Uses of geothermal energy as seen by a small geothermal developer.** Boren, K. Sep 1980. NTIS, PC A07/MF A01. Order Number DE81023998.

From Geothermal symposium: potential, legal issues, economics, financing; Seattle, WA, USA (2 Jun 1980).

Four geothermal projects are described briefly. A large operating hydroponic vegetable complex in Northern California housed in geothermally heated greenhouses is described. A hybrid geothermal/wood residue 55MW power plant is planned for Lassen County, California. The feasibility of a planned geothermal district heating system for a new development near Fernley, Nevada is discussed. A second-generation ethanol-from-cellulose process has been developed and is being designed to use geothermal energy in Hawaii. (MHR)

34666 **(WAOENG—80-16, pp XIV.1-XIV.3) Utility perspective.** Petterson, C.N. (Northwest Geothermal Corp., Portland, OR). Sep 1980. NTIS, PC A07/MF A01. Order Number DE81023998.

From Geothermal symposium: potential, legal issues, economics, financing; Seattle, WA, USA (2 Jun 1980).

The experience of a gas utility in geothermal exploration and resource development is discussed, as it relates to geothermal district heating. (MHR)

### 1520 Geothermal Data And Theory

*REFER ALSO TO CITATION(S) 34642*

34667 **(DOE/ET/28384—T1, pp 91-104) Viscosity of geothermal brines.** Apr 1981. NTIS, PC A06/MF A01.

In Formation evaluation in liquid-dominated geothermal reservoirs.

The dynamic viscosities of NaCl, KCl, and $CaCl_2$ were measured and their behavior at elevated temperatures and various levels of dissolved ion concentrations were compared. (MHR)

## 17 WIND ENERGY

### 1701 Availability (climatology)

34668 **(PNL—3864) Numerical wind-speed simulation model.** Ramsdell, J.V.; Athey, G.F.; Ballinger, M.Y. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1981. Contract AC06-76RL01830. 88p. NTIS, PC A05/MF A01. Order Number DE82000956.

A relatively simple stochastic model for simulating wind speed time series that can be used as an alternative to time series from representative locations is described in this report. The model incorporates systematic seasonal variation of the mean wind, its

standard deviation, and the correlation speeds. It also incorporates systematic diurnal variation of the mean speed and standard deviation. To demonstrate the model capabilities, simulations were made using model parameters derived from data collected at the Hanford Meteorology Station, and results of analysis of simulated and actual data were compared.

### 1704 Economics

*REFER ALSO TO CITATION(S) 34672*

### 1705 Environmental Aspects

34669 **(DOE/ET/20510—T2) Programmatic environmental assessment wind-energy-conversion systems (WEC) program. Issues-identification report.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). 2 Mar 1979. Contract AC03-78ET20510. 30p. NTIS, PC A03/MF A01. Order Number DE81027410.

This report briefly describes environmental issues that may be associated with deployment of wind energy conversion systems (WECS). It is expected that these issues will be further elaborated and qualified to form the core of the impacts section of the WECS programmatic EA. However, the identified issues may be modified or refined and new issues added as analytical efforts continue and new information develops.

### 1706 Wind Energy Engineering

*REFER ALSO TO CITATION(S) 34668*

34670 **(DOE/ET/29100—T1) Security assessment of power systems including energy storage and with the integration of wind energy. Progress report, April 1, 1981-June 30, 1981.** Carroll, D.P.; Krause, P.C. (Purdue Univ., Lafayette, IN (USA). School of Electrical Engineering). Jul 1981. Contract AS02-77ET29100. 17p. (COO—29100-17). NTIS, PC A02/MF A01. Order Number DE81030166.

On June 3, 1981 a presentation was made to DOE which summarized the work on this contract during the last year. In particular, the papers on Methods of Resynchronizing Wind Turbine Generators, and Performance of Wind Turbines in a Turbulent Atmosphere, were discussed in detail. Copies of these papere were given in previous quarterly reports. As during the previous quarter, work during this quarter continued in reduced order modeling and aggregation. The work on reduced order modeling by SEPI is reported. Aggregation techniques which have been formulated are being validated. Until the development and validation of these techniques are complete, these ideas on aggregation will not be reported in detail. Work on reduced models and aggregation of multiple-units will continue for the remainder of this contract.

34671 **(SAND—81-1156) Vertical axis wind turbine control strategy.** McNerney, G.M. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1981. Contract AC04-76DP00789. 21p. NTIS, PC A02/MF A01. Order Number DE81031932.

Early expensive in automatic operation of the Sandia 17-m vertical axis research wind turbine (VAWT) has demonstrated the need for a systematic study of control algorithms. To this end, a computer model has been developed that uses actual wind time series and turbine performance data to calculate the power produced by the Sandia 17-m VAWT operating in automatic control. The model has been used to investigate the influence of starting algorithms on annual energy production. The results indicate that, depending on turbine and local wind characteristics, a bad choice of a control algorithm can significantly reduce overall energy production. The model can be used to select control algorithms and threshold parameters that maximize long-term energy production. An attempt has been made to generalize these results from local site and turbine characteristics to obtain general guidelines for control algorithm design.

34672 **Mod 2 wind turbine development project.** Kennard, J.G. (National Aeronautics & Space Administration, Cleveland, OH). pp 75-97 of Proceedings of third annual energy seminar. Erie, PA; Gannon University (1981).

From 3. annual energy seminar; Erie, PA, USA (31 Mar 1981).

The primary objective in the development of Mod 2 was to design a wind turbine to produce energy for less than 5 cents/kWh based on 1980 cost forecasts. The pricing method used to project the Mod 2 energy costs is the levelized fixed charge rate approach, generally accepted in the electric utility industry as a basis for relative ranking of energy alternatives. This method derives a levelized energy price necessary to recover utility's purchasing, installing, owning, operating, and maintenance costs.

## 20 ELECTRIC POWER ENGINEERING

*REFER ALSO TO CITATION(S) 34977*

34673 **(EPRI—908-1) Long-term system-dynamics hybrid simulation. Final report.** Ott, G.E.; Walker, L.N.; Harbourt, C.O.; Wong, D.T.Y. (Missouri Univ., Columbia (USA). Dept. of Electrical Engineering). May 1975. 188p. NTIS, PC A09/MF A01. Order Number DE82900062.

Progress on a study of the long term dynamics of power systems using hybrid simulation is reported. A hybrid simulator was designed, constructed and tested at the University of Missouri-Columbia. The sample system consists of 16 machines and 68 buses. Each power system component was implemented in electronic integrated circuits and was contained on 8" x 10 1/2" printed circuit cards. The power system model is an ac, single phase, variable frequency, faster-than-real-time simulation. The analog simulation was scaled to operate 20 times faster-than-real-time thus the base frequency is 1200 Hz. Therefore a 20 minute real time run can be obtained in one minute system running time. A 16-bit digital minicomputer was used for input, output and control of the analog simulation. A special purpose digital/analog interface controller was designed and built to achieve the desired data collection and control functions. The necessary software was developed to operate the simulator. The analog power system models include all of the specific components which influence the long term dynamics. Since the objective of this project was to develop the simulator specifically for the long term dynamics, the factors affecting only the short term dynamics have been excluded. A description of the hybrid simulator, operating instructions and results of the studies performed are presented. (WHK)

### 2001 Power Plants And Power Generation

*REFER ALSO TO CITATION(S) 34484, 34486, 34487, 34920, 34921, 34950, 34950, 34976, 35089, 35130, 35359, 35360*

34674 **(DOE/SF/10538—T10) Update on specified European R and D efforts. Part I. Appendices.** (Galaxy, Inc., Washington, DC (USA)). Oct 1980. Contract AC03-79SF10538. 117p. NTIS, PC A06/MF A01. Order Number DE81026404.

These appendices to a report entitled Updata on Specified European R and D Reports contains the following papers: Blueburner test with different swirl spray nozzles; the aerodynamics of a flat non-swirl blue flame; and large industrial blue flame burners. Manufacturer's design and performance literature for the 2500 to 3500 KW KG5 gas turbine, the Kongsberg 1500 to 2000 kVA generating set, the 500 to 700 kVA generating set, the KG 831 gas turbine generating set, the KG 2 gas turbine, and selection criteria for gas turbines for emergency power supplies; and two reports in German on high temperature corrosion and carburization and silicon coatings as high temperature corrosion protection for gas turbine blades. (LCL)

34675 **(EPRI—265-1) Assessment of the capability of firing clean low-Btu gases in existing coal, oil, and gas-fired steam generators. Final report.** (Combustion Engineering, Inc., Windsor, CT (USA)). Dec 1975. 92p. NTIS, PC A05/MF A01. Order Number DE82900018.

Objective of this study is to assess the capability of existing steam generating units in electric utility plants when firing low-Btu gas (LBG). The assessment includes: determining the maximum generating capacity without making any modifications to existing pressure parts or auxiliary components; establishing the minimum heating value of LBG that could be used to obtain original maximum continuous rating; defining the alterations and estimating the order of magnitude costs which would be required to achieve original maximum continuous rating; and providing performance data to make a comparative evaluation of LBG firing. This study includes an evaluation of five different low Btu gases with heating values of 105 Btu/scf, 128 Btu/scf, 179 Btu/scf, 292 Btu/scf and 396 Btu/scf. Six typical modern type steam generating units, randomly selected for this study, range in size from 250 to 900 MW, include both subcritical and supercritical pressure steam cycles, and were originally designed with tangential firing systems to fire one of the predominant fossil fuels, i.e. pulverized coal, fuel oil or natural gas.

34676 **(EPRI-AP—1934) Advanced cooling full-scale engine demonstration. Final report.** (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). Jul 1981. 215p. NTIS, PC A10/MF A01. Order Number DE81904253.

A program was performed to demonstate the advantages of advanced fabrication techniques for convectively cooled airfoils for utility combustion turbines. The program focused on airfoils fabricated from thin sheets of metal (water airfoil). The objectives of the program were to demonstrate that utility combustion turbine sized wafer airfoils could be fabricated, low metal temperatures could be achieved, corrosion, erosion and deposition problems could be relieved, and that there were economic benefits for fabricated airfoils. The results of the program show that wafer airfoils could be fabricated in utility combustion turbine sizes. Low metal temperatures were achieved in a conceptual design, but experimental verification was not obtained for programmatic reasons. Tests to show that corrosion, erosion, and deposition problems were relieved through the use of wafer airfoils were largely inconclusive because of unanticipated problem with the test method. It was shown that there are economic benefits for wafer airfoils relative to conventionally cast airfoils. However, these benefits are not large relative to benefits achievable by another fabrication technique. This other fabrication technique is the bonded airfoil, which has a higher degree of development and for which there is a manufacturing capability at United Technologies Corporation.

34677 **(EPRI-AP—1937) Repowering oil-fired boilers with combustion turbines fired with gas from coal. Final report.** Garland, R.V. (Westinghouse Electric Corp., Concordville, PA (USA)). Jul 1981. 227p. NTIS, PC A11/MF A01. Order Number DE81904243.

The results of a study on repowering of oil fired reheat steam plants using combustion turbines and coal gas from the Texaco oxygen blown gasifier are presented. The steam plant utilizes combustion turbine exhaust gas as its combustion air supply. In some examples coal gas is fired in both the combustion turbines and the main boiler, while, in other cases, oil firing is retained in the boiler. Plant configurations, equipment changes, and performance are determined for three basic forms: (1) repowering based on coal gas supplied by pipeline (remote source); (2) repowering based on complete integration of the gasification system with the power plant; and (3) repowering based on partial integration of the gasification system wherein the boiler retains oil firing.

34678 **(EPRI-AP—1975) Evaluation of shale oil as a utility gas-turbine fuel. Final report.** Grasso, A.P.; Sederquist, R.A.; Sykes, F.G.; Frese, J.; McVey, J.; Lewis, G.; Mathason, J. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). Aug 1981. 139p. NTIS, PC A07/MF A01. Order Number DE81904234.

An FT4A-9 engine test was run at Long Island Lighting Company (LILCO), and a selected single-can combustor from the LILCO engine was run at United Technologies Research Center (UTRC). Performance and emission tests were run with No. 2 petroleum distillate fuel and hydrotreated Paraho shale oil residual, with and without water injection. The engine operated successfully with low smoke when running on shale oil residual and No. 2 petroleum distillate fuel. The use of hot water injection was successfully demonstrated with reduced NO/sub x/ emissions when operating on both fuels. The Environmental Protection Agency (EPA) NO/sub x/ limit of 75 ppM for nitrogen free fuel, corrected to 15% oxygen, was easily met at a water-to-fuel ratio of 0.38 with No. 2 petroleum distillate fuel. The limit of 125 ppM for fuels containing 0.25% nitrogen or greater was close to being met at 18.5 MW with shale oil residual at a water-to-fuel ratio of 0.79. Post-test engine inspection showed that all combustor components, including turbine inlet vanes, were in good condition. NO/sub x/ emissions from single-can combustor testing with both fuels exceeded engine levels. Carbon monoxide and unburned hydrocarbons were slightly lower. These differences appear to be due to the placement of the gas sampling probes in the single-can tests. Smoke levels were low and NO/sub x/ reduction trends with water injection were comparable to engine results.

34679 **(EPRI-AP—1981) Investigation and research of specific combustion-turbine and combined-cycle field problems. Annual report.** (COECORP, Mountain View, CA (USA); Aptech Engineering Services, Inc., Palo Alto, CA (USA)). Aug 1981. 62p. NTIS, PC A04/MF A01. Order Number DE81904231.

During 1980, EPRI coordinated the investigation and research efforts dealing with five specific combustion turbine and combined cycle field problems. These are (1) fuel filter plugging, (2) apparent compressor surge, (3) oily waste water, (4) compressor wheel failure, and (5) combustor problems. EPRI coordination efforts are detailed, and the results of the efforts are outlined.

34680 **(EPRI-CS—1838) Magma cooling-tower process pilot-plant demonstration. Final report.** Sanderson, W.G. (Tower Systems, Inc., Tacoma, WA (USA)). May 1981. 159p. NTIS, PC A08/MF A01. Order Number DE81903783.

The Magma Cooling Tower (MCT) is a new process which offers a low energy approach for evaporation and concentration of waste water. A three month test program of the MCT portable pilot plant was conducted at the Sunrise Station of Nevada Power Company for the purpose of demonstrating this new technology. The MCT contains vertically oriented water-water-air falling film heat exchangers which are configured for indirect cooling of a primary fluid through evaporation of a secondary fluid into an air stream. The secondary fluid is contained in a circulating loop within the MCT and is composed of treated plant waste water. The secondary fluid is exposed primarily to low temperature non-metallic surfaces and can be maintained at very high dissolved solids levels. The principal objective of the program was to demonstrate the capability of the MCT to evaporate and concentrate waste water blowdown using low quality waste energy from the cooling water loop. A second objective was to demonstrate the control of scaling, fouling and corrosion in the high solids brine environment of the MCT secondary loop. Two modes of scale control were tested during the program. The first mode was based on chemical softening of makeup water to the secondary loop and was preferred for the NPC application. The second mode was baed on controlled crystallization of scale forming agents within the secondary circulating loop. The Magma Cooling pilot plant test was successful; and evaporation, scale control, and waste concentration were demonstrated. Results were within the limits predicted prior to the test. It was concluded that the Magma Cooling Tower is a viable mature technology which should be considered along with other water management techniques available to the industry.

34681 **(EPRI-CS—1967) Steam turbine blades: considerations in design and a survey of blade failures.** Bates, R.C.; Heymann, F.J.; Swaminathan, V.P.; Cunningham, J.W. (Westinghouse Electric Corp., Pittsburgh, PA (USA); Westinghouse Electric Corp., Philadelphia, PA (USA)). Aug 1981. 127p. NTIS, PC A07/MF A01. Order Number DE81904249.

Thermo-mechanical considerations and material selection criteria for the design of steam turbine blades are discussed from the mechanical engineer's point of view in the first two sections of this report. Sources of vibratory excitation, the response of blades to these excitations, the stress levels and load histories that result from

this reponse, and various design features incorporated into steam turbine LP blading to minimize or resist these stresses are covered. Blading alloy properties of concern to the blade designer are discussed and compared, and parameters to be used in fatigue testing recommended. The third section of the report describes several blade failure surveys. In addition to a literature survey, results of a questionnaire on LP blade failures to American utilities and a review of recent Westinghouse experience are presented. Correlations between the number of failures and parameters such as blade life, failure location in the turbine and on the blades, alloy, deposit chemistry, steam source, feedwater treatment, cooling water source, balance of plant problems, and temperature and pressure at the failed row are attempted.

**34682 (EPRI-CS—1979) Control of fan erosion in coal-fired power plants: Phase 1. Final report.** Sverdrup, E.F.; Menguturk, M.; Glasser, A.D. (Westinghouse Research Labs., Pittsburgh, PA (USA)). Aug 1981. 159p. NTIS, PC A08/MF A01. Order Number DE82900379.

This EPRI sponsored project examines ways of controlling fly-ash erosion in power plant fans. Computer calculations of particle trajectories and resulting erosion damage show the relative erosion tolerance of various fans. Airfoil centrifugal fans commonly used for induced-draft service have the highest fly-ash erosion tolerance. The erosivity of fly ash from burning bituminous coals, subbituminous coals, and lignites was studied. Fly ash of the highest silica content showed nearly the full range of erosivity indicating that silica content by conventional chemical analysis is not a reliable predictor of expected erosion rates. Work is continuing to speed commercialization of field-replaceable erosion armor for electric utility fans. If the equivalent added protection of 0.2 to 0.3 in. of steel is required, chrome-plated steel shields can be used and still be within the weight limits that will not overstress most fans. If the erosion rates are so high that the equivalent of 0.3 to 0.6 in. of steel are required, shields with advanced coatings will be required. The factors in obtaining highly erosion-resistant coatings are shown and the erosion resistances of promising advanced coatings compared.

**34683 (EPRI-CS—1990) Assessment of rotor-bearing dynamics: a planning study for the utility industry. Final report.** Tecza, J.A.; Zorzi, E.S. (Mechanical Technology, Inc., Latham, NY (USA)). Aug 1981. 150p. NTIS, PC A07/MF A01. Order Number DE82900378.

This report presents the results of an EPRI-sponsored study to determine the current state of the art with regard to the rotor-bearing analysis of large steam turbine-generators, to seek out the needs of American utilities with regard to rotor vibration related problems and to develop an R and D plan to fulfill those needs. The overall goal is eventually to be able to provide utilities with needed analysis tools and techniques to reduce machine downtime and associated outage costs. Information has been drawn from an extensive literature search and from interviews with US and European utilities and US, European and Japanese manufacturers. Presented are a justification of the need for improved analysis methods, a summary of current American capabilities and practices, the needs of the utility industry in this area which appear most pressing and a plan for addressing them. This plan calls for, among other things, improved analytical tools, development of advanced machinery monitoring techniques, generation of objective criteria with which to judge the potential smoothness of operation of a turboset design and the transfer of expertise in the use of analytical tools to utility personnel who most need to use them.

**34684 (EPRI-CS—1990-SY) Assessment of rotor-bearing dynamics: a planning study for the utility industry. Summary report .** Tecza, J.A.; Zorzi, E.S. (Mechanical Technology, Inc., Latham, NY (USA)). Aug 1981. 22p. NTIS, PC A02/MF A01. Order Number DE81904242.

This summary report presents results, recommendations, and conclusions drawn from a program effort to determine the current state of the art of rotor and bearing dynamic analyses of large steam turbine generators. The conclusions are grouped into three main areas of rotordynamic analysis, bearings, and condition monitoring. Budgetary estimates and program schedules are included.

**34685 (EPRI-CS—2027) Development of advanced rotor-bearing systems for feedwater pumps. Phase 2.** Adams, M.L. Jr.; Makay, E. (Akron Univ., OH (USA); Energy Research and Consultants Corp., Morrisville, PA (USA)). Sep 1981. 71p. NTIS, PC A04/MF A01. Order Number DE82900376.

This report summarizes the second phase of an ongoing four-phase effort to develop design improvements which reduce feed pump vibration problems. Excessive vibration is a common cause of feed pump forced outages, accounting for a significant amount of forced power reduction throughout the electric utility industry. In addition, a byproduct of excessive feed pump vibration is high maintenance costs due to the shortened lives of various pump components such as seals, wear rings, shafts, bearings and thrust balancers. Earlier studies of the Phase-1 project showed that present feed pump rotor-bearing systems frequently suffer from a lack of sufficient damping with which to control the vibration induced by various hydraulic excitation forces within the pump. The overall approach on the problem is to devise high-damped rotor-bearing configurations. Described in this report are two important components of this approach; the development of squeeze-film dampers for feed pump applications and the search for interstage sealing configurations which will provide additional vibration damping at mid-span locations between the journal bearings.

**34686 (EPRI-CS—2028) Identification of root causes of plant outages attributed to boiler controls. Final report.** Carlson, J.R. (JAYCOR, San Diego, CA (USA)). Sep 1981. 49p. NTIS, PC A03/MF A01. Order Number DE82900358.

The availabilty of fossil-fueled power plants is directly related to the reliable operation of all system components. The boiler control system was identified by EPRI as having a moderately high impact on plant availability. This two-phase investigation provides insight into the nature of boiler control problems, identifies common failure modes, established associated root causes, and suggests means of eliminating or alleviating the problems. The initial phase of the investigation reviewed the existing data base concerning boiler control problems and expanded it such that common symptoms and abnormal events differing from the expected behavior could be identified and ranked according to frequency. The second phase identified distinguishing symptoms, ranked common root causes, and suggested corrective action. Results from Phase I identified the boiler startup sequence as the operating mode experiencing most problems. This was true for all types of boilers, but particularly for once-through units. Startup problems were most frequently attributed to the turbine bypass valves (once-through units) and to flame ignition (all units). Phase II results revealed that the probable causes of the failures were extreme service requirements, hostile environment, and personnel-induced damage. Therefore, the control components must be protected from both internal and external contamination (moisture, fly-ash, and weather) as well as physical damage (vibration, heat, and personnel). This goal can be achieved through improved system design, hardware specifications and maintenance procedures.

**34687 (EPRI-CS—2029) Failure-cause analysis: fossil-fired boilers, pressure parts. Final report.** Wood, R.A.; Williams, D.N.; Berry, W.E.; Payer, J.H. (Battelle Columbus Labs., OH (USA)). Sep 1981. 129p. NTIS, PC A07/MF A01. Order Number DE82900377.

Root-cause failure analyses were conducted to determine the reason for high forced-outage rates attributed to boiler-pressure-part failures in four medium-sized fossil-fired electricity generating units. Those analyses were conducted not only to identify the reasons for the high forced-outage rates in the four boilers selected for study, which are discussed in detail in this report, but also to identify areas where research studies directed toward the solution of specific failure problems related to boiler pressure parts could be expected to increase the availability of both existing and future medium-sized fossil-fired units. Twenty-four such areas were identified, six related to analyzing causes of component falures, nine related to improving equipment or operating procedures, and nine related to increasing fundamental knowledge of factors causing boiler tube degradation. The systematic problem-solving approach used in conducting the root-cause analyses is described in sufficient detail to allow utilities to apply similar techniques, if desired, for analyzing failures of other power plant equipment.

34688 **(EPRI-EL—726-Pt.2) Frequency-domain analysis of low-frequency oscillations. Part 2. Modeling. Interim report.** Byerly, R.T.; Sherman, D.E.; Bennon, R.J. (Westinghouse Electric Corp., East Pittsburgh, PA (USA). Advanced Systems Technology Div.). Apr 1978. 73p. NTIS, PC A04/MF A01. Order Number DE82900013.

This report describes mathematical models and computing methods for determining the natural frequencies and damping of generator rotor oscillations in large electric power systems. These models and methods provide the basis for estimating those eigenvalues most intimately related to rotor motion. The principal computational problem is the calculation of incremental voltage oscillations in a linear system model subjected to an external forcing function. This linear system model is derived from networks and generator representations employed in conventional time domain stability calculations. Methods of calculating voltages using this model are discussed. The use of these voltages in an iterative process to estimate eigenvalues is explained.

34689 **(EPRI-SR—21) State-of-the-art review of the application of minicomputers and digital techniques to power generating stations, substations, and protective relaying. Special Report 21.** (Schleif (Ferber R.), Denver, CO (USA)). Nov 1975. 29p. NTIS, PC A03/MF A01. Order Number DE82900102.

Minicomputers have already found wide application in power generating stations and substations for instrumentation, data acquisition, supervisory control, automatic control, and other diverse functions. Their inherent multifunction capability has made it convenient and economical to combine functions formerly served by dedicated apparatus into larger coordinated systems. Applied as overlays to existing control and instrumentation systems mainly for passive functions of collecting, processing, and presenting data for operator aid, they reduce manpower requirements, facilitate operations, and improve security. Incorporated in new designs, they permit more efficient man-machine interfacing and incorporate more supervisory and automatic control. The automatic control is effected mainly through set point adjustment at the secondary and higher hierarchical control levels while the primary control loops such as governors and voltage regulators predominantly remain independent dedicated controls, mainly analog in nature. While use of direct digital control in primary loops is possible, it has seldom proven advantageous so far. Protective relaying by minicomputers has been demonstrated to be technically feasible, but so far economic advantage for first-level protective relaying has not been developed. More advantageous applications have been as flexible backup systems.

34690 **Boiler plant training.** Peffley, R.E. Lexington, KY; University of Kentucky (1980). 5p. (CONF-8004173—5).

From 19. annual Kentucky industrial coal conference; Lexington, KY, USA (30 Apr 1980).

Developing an operator training program depends on each individual power plant's operating characteristics. This paper deals with the development of the existing, workable program used at the Eckert and Erickson Stations - Board of Water and Light, Lansing, Michigan. The Eckert Station is a coal fired complex consisting of 3 to 45 MW, 3 to 80 MW, and 4 process steam boilers. This training program encompasses seven (7) operating classifications administered by a Head Operator. A similar program is employed at a single unit 160 MW Erickson Station, covering three (3) operating classifications.

## 2002 Environmental Aspects

*REFER ALSO TO CITATION(S) 34238, 34247, 34295, 34695, 34950, 35413, 35414, 35421, 35423, 35427, 35474*

34691 **(BNL—30046) Carbon dioxide power plant for total emission control and enhanced oil recovery.** Horn, F.L.; Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). Aug 1981. Contract AC02-76CH00016. 28p. NTIS, PC A03/MF A01. Order Number DE81030734.

The design of a compact environmentally acceptable carbon dioxide diluted coal-oxygen fired power plant is described. The plant releases no combustion products to the atmosphere. The oxygen for combustion is separated in an air liquefaction plant and the effluent nitrogen is available for use in oil well production. Recycle carbon dioxide mixed with oxygen replaces the nitrogen for the combustion of coal in the burners. The carbon dioxide produced is used in enhanced oil recovery operations and injected into spent wells and excavated salt cavities for long-term storage. The recovery of $CO_2$ from a coal-burning power plant by this method appears to have the lowest energy expenditure and the lowest by-product cost compared to alternative removal and recovery processes.

34692 **Engineering critique of the EPA's NSPS for electric utility steam generating units.** Harris, L.S. (H.K. Ferguson Co., Cleveland, OH). pp 33-43 of Proceedings of third annual energy seminar. Erie, PA; Gannon University (1981).

From 3. annual energy seminar; Erie, PA, USA (31 Mar 1981).

This ASME critique is limited to the proposed EPA New Source Performance Standard (NSPS) for $SO_2$ from electric utility steam generating units. It is possible that little, if any, improvement in $SO_2$ emission will be achieved from the proposed regulations (based on scrubbing) in the midwest and only minor improvements nationally and in the east. An emphasis on physical coal cleaning with partial and full compliance on a regional basis to the new standards would be more practical. 4 figures. (DLC)

34693 **Kaiparowits coal project and the environment: a case study.** Jepperson, R.; Hemel, E.; Hauptman, R. Ann Arbor, MI; Ann Arbor Science Publishers, Inc. (1981). 115p. (EPRI-EA—1620).

The Kaiparowits power plant in southern Utah, was to have been the largest coal-burning plant in the United States, consuming nine million tons of low-sulfur coal a year and producing 3000 megawatts of electricity. This case study focuses on the role that environmental politics played in cancellation of the Kaiparowits project. The study analyzes the Kaiparowits project history in order to raise a number of important environmental, political, regulatory, and economic issues associated with energy expansion and environmental protection. Chapter 2 outlines the project's history. Chapter 3 characterizes the uncertainty over Kaiparowits' environmental effects and the differing interpretations of the Kaiparowits Environmental Impact Statement. This chapter also presents the debate over the need for the Kaiparowits project and the dispute over energy demand projections. Chapter 4 concentrates on the environmentalist role in the project's history. Chapter 5 analyzes the federal regulatory context and the decision-making processes in the Department of Interior relevant to Kaiparowits. Chapter 6 characterizes the changing constraints on utility decision-making and the different factors underlying the utility decision to withdraw the Kaiparowits application. A number of questions regarding the wider effects and implications of the Kaiparowits withdrawal are raised in the concluding chapter.

## 2003 Power Transmission And Distribution

*REFER ALSO TO CITATION(S) 35354*

34694 **(EPRI—282) Feasibility study of a multipurpose refrigerator for a superconducting cable test facility. Research Project 282, final report.** Strobridge, T.R. (National Bureau of Standards, Boulder, CO (USA)). Jul 1975. 52p. NTIS, PC A04/MF A01. Order Number DE82900229.

A major problem in simultaneously cooling a number of test sections of superconducting power transmission cables is the wide variation in cable operating pressures and temperatures. It is feasible to couple a single large refrigerator to the cables with individual pumped helium circulation circuits. The system is flexible in both pressure and temperature and in the temperature rise along the length of the cable. The total refrigeration capacity required for a test facility is derived from current estimates of cable characteristics. A single refrigerator is shown to be less expensive than individual refrigerators for each cable even when the penalties for pump work and heat transfer through large temperature differences are included. Sufficient process calculations are included to show

that the system is practical, and a draft specification for the refrigerator is given.

34695 **(EPRI—381-1) Biological effects of high-voltage electric fields: state-of-the-art review and program plan. Final report.** Bridges, J.E. (IIT Research Inst., Chicago, IL (USA)). Nov 1975. 206p. NTIS, PC A10/MF A01. Order Number DE82900239.

The overall objective of the suggested five-year research plan is to develop sufficient understanding of how power frequency electric and magnetic fields interact with organisms on which to base safe and compatible biological criteria for the design of overhead transmission lines. The developed data may ultimately be used as a basis for developing design standards and limits. The efforts reported have considered the direct effect of fields from power lines on living organisms in order to: (1) definitively review and evaluate relevant past and ongoing research, and (2) produce the required short and long-range research programs. This plan addresses the direct effects of fields and selected indirect effects, such as might occur for patients with electronic-cardiac pacemakers. Progress is reported. (WHK)

34696 **(EPRI-TD—126) Development of a foamed-glass power pole derived from fly ash. Final report of Research Project 482, Phase I.** Williams, T. (ECP, Inc., Los Angeles, CA (USA)). Apr 1976. 147p. NTIS, PC A07/MF A01. Order Number DE82900142.

Phase I of this research activity was designed to validate the physical parameters and economics of a power pole made from foamed glass. The results of the research activity indicated that a 18.28 m (60 ft.) class 1 power pole could be made from foamed glass with fly ash filler for about $77 in a 199 x $10^3$ kg (220 ton) a day glass facility. The foam glass with fly ash filler has exhibited strengths in large samples of 3448 N/cm$^2$ to 4137 N/cm$^2$ (5000 to 6000 psi) for densities of 1.0 to 2.3 gm/cc and impact resistance equal to or greater than concrete or brick. Analysis of the pole design revealed that a hollow circular pole would be best suited for both load carrying and cross arm attachment. Other more efficient pole designs such as elliptical or dog-boned could carry the required force for less material, but standard attachments are not available. As the diameter of a hollow circular pole is increased, its moment of inertia increases, its strength/material ratio improves and its cost lowers. This trend is limited by esthetics and real estate constraints. Steel reinforcing through poststressing has been shown in our finding not to be as cost effective as increasing the diameter of the pole. A class 1 pole would have a 52.8 cm (20.8 in.) diameter for a foam glass design strength value of 4137 N/cm$^2$ (6000 psi). Pole tapering was also found to be not only esthetic but effective in providing lower cost poles per strength classification. If 20% of the utility pole market is satisfied by foamed glass poles, a savings of over $100,000,000/year is possible. This would also have the effect of using over one million tons of two under utilized resources: fly ash and waste glass.

34697 **(EPRI-TD—204) Switching tests of separable insulated connectors. Final report.** (American National Standards Inst., Washington, DC). Jul 1976. 42p. NTIS, PC A03/MF A01. Order Number DE82900025.

Separable insulated loadbreak connectors were first introduced in 1964, and placed in actual service in 1965, for use with underground distribution systems. Standardization work was begun in 1967 by the IEEE working group on Separable Insulated Connectors which later merged with the NEMA Primary Connector Working Group to form an IEEE-NEMA Task Force. Standardization work was later transferred to the American National Standards Institute. Their efforts led to the approval of American National Standard C119.2-1974 in July 1974. Variations in switching performance began to be reported in 1972 and 1973 when products with comparable ratings were evaluated in various testing laboratories. This evidence prompted industry standardizing organizations such as three-phase operation and the presence of adjacent grounded surfaces that appeared to significantly affect the switching performance of loadbreak connectors. Accordingly, a Reliability Working Group which included both users and manufacturers was established by the ANSI Subcommittee on Separable Insulated Connectors and began work in March of 1974 to draft a comprehensive revision of the switching performance portion of the standard. The key circuit parameters, test procedures and test conditions, including fixtures, that might affect switching performance were discussed and defined during a series of meetings. The need to evaluate these factors prior to the actual revision of the standard became obvious. An expedient way to answer the important questions raised by these changes was to test representative samples of loadbreak devices in a variety of test circuits and laboratories. Test procedures, results, and conclusions are reported.

34698 **(LA-UR—81-2119) Partial discharge characteristics of liquid-impregnated laminate dielectric structures.** Bickford, K.J.; Sarjeant, W.J.; Mauldin, G.H. (Los Alamos National Lab., NM (USA); Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract W-7405-ENG-36. 9p. (CONF-811112—1). NTIS, PC A02/MF A01. Order Number DE81028745.

From IEEE conference on electrical insulation and dielectric phenomena; Pokenose, NJ, USA (Nov 1981).

Foil-edge partial discharge phenomena in high energy density, spirally-wound capacitors have been investigated. A partial discharge dependency on V has been found to exist in liquid-impregnated, laminar plastic film dielectric structures. Experiments support the hypothesis that electric charges are injected into the dielectric regions near the foil edge by field-controlled charge injection during impressed voltage transients. The resulting conduction current space charge can establish equilibrium by reduction of the electric field intensity below the partial discharge inception threshold. A temporal characterization of this space charge injection is discussed relative to the effect on partial discharge inception at the foil edge.

34699 **(NYSERDA—81-8) Evaluation of advanced technologies for power transformers. Final report.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). Jan 1981. Contract AC01-77ET29069. 173p. NTIS, PC A08/MF A01. Order Number DE82000793.

The high insulating strength of certain gases, such as sulfur hexafluoride, when used at high pressure, suggests that there may be advantages to compressed gases as the insulating fluid in power transformers. However, simply exchanging the oil for compressed gas in an otherwise conventional transformer design will not yield a significant overall advantage. Compressed gases present the engineer with properties which are quite different from mineral oil. If gases are to be used as the major insulating fluid in power transformers, then virtually all aspects of the insulation and cooling of the apparatus must be reconsidered, affording an opportunity to introduce new design concepts, new materials, and new construction techniques. In this program, the feasibility of using the following principal design concepts has been explored: sheet conductors for the windings; a system of sealed, self-contained, annular cooling ducts containing circulating cooling fluid to cool the windings; polymer film for turn-to-turn insulation; and compressed gas insulation. Experimental and analytical studies, described in this report, indicate that the sheet-wound, compressed-gas-insulated design should result in power transformers of significantly smaller size and weight when compared with oil-filled units of equivalent rating. These advanced technologies offer the opportunity for the design of more efficient power transformers.

34700 **Construction and properties of a 1-m long $Nb_3Ge$-based ac superconducting power transmission cable.** Thompson, J.D.; Maley, M.P.; Newkirk, L.B.; Valencia, F.A.; Carlson, R.V.; Morgan, G.H. (Los Alamos Sci Lab, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-17**: No. 1, 149-152(Jan 1981). (CONF-800980—).

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

A prototype 1-m long, coaxial ac superconducting power transmission cable utilizing $Nb_3Ge$-clad tapes was constructed. Tapes up to 20-m long were produced by pulling 25-Z=m thick by 0.64-cm wide copper substrates through a continuous coating chemical vapor deposition reactor. $Nb_3Ge$ layer coating thicknesses in the range 3-5 $\mu$m were deposited on both surfaces and around the edges of the substrate. A total of 50 m of $Nb_3Ge$-coated tapes

were incorporated in this cable. The cable was fabricated after the BNL double-helix design. Losses measured in the cable were found to be high. 11 refs.

**34701 Application of superconducting coils to reactive power control in electric power systems.** Boenig, H.J.; Hassenzahl, W.V. (Los Alamos Sci Lab, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-17**: No. 1, 517-520(Jan 1981). (CONF-800980—).

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

A novel type of static thyristor-controlled reactive power compensator, called SAVAR, consisting of a multipulse Graetz bridge controlled in a variable free wheeling mode and connected to a superconducting coil is described. Each thyristor of the Graetz bridge is fired twice during a cycle resulting in a constant average coil current which flows through the line during part of a cycle and free wheels through the bridge during the rest of the cycle. By varying the fraction of a cycle during which the coil current is free wheeling, the line current can be varied continuously between a minimum and maximum according to the required reactive current demand. The control algorithm for the variable free wheeling mode of the bridge and the methods to produce a low pass superconducting coil subjected to high-voltage harmonics are described. Experimental results of a prototype unit with an existing nonoptimized superconducting coil are given. 4 refs.

# 21 NUCLEAR POWER PLANTS

*REFER ALSO TO CITATION(S) 34869, 34907*

**34702** (NUREG/CP—0014(Vol.1), pp 663-706) **Flow-induced vibration phenomena in nuclear power station components.** Pettigrew, M.J. (Atomic Energy of Canada Ltd., Chalk River, Ontario). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

This paper is an overview of flow-induced vibration phenomena with reference to the more pertinent problems in nuclear power station components. Flow-induced vibration excitation mechanisms in both axial and cross-flow are reviewed. Other vibration considerations such as damping, hydrodynamic mass, acoustic resonance, and nuclear fuel dynamics are outlined. Vibration phenomena in two-phase flow are discussed. The emphasis is on the prevention of flow-induced vibration problems in nuclear components by thorough analysis at the design stage.

**34703** (NUREG/CP—0014(Vol.3), pp 1979-2023) **Mathematical methods in nuclear-reactor thermal hydraulics.** Spalding, D.B. (Imperial Coll., London, England). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A review is made of the mathematical problem of predicting the flow of interspersed phases, possessing differing (average) velocities at the same instant and location, and of successful methods of solving the problem. It is argued that, the mathematical difficulties having now been overcome, further attention should be devoted, on the computational side, to faster algorithms and more flexible computer codes; and, on the physical side, to the development of models for interfacial area, interphase transport, and interactions with solid structural elements.

**34704** (NUREG/CP—0014(Vol.3), pp 2024-2046) **Implicit thermohydraulic coupling of two-phause flow calculations.** Lekach, S. (Brookhaven National Lab., Upton, NY); Kaufman, J.M. 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A numerical scheme that implicitly couples the hydraulic variables with thermal variables during a one or two-phase transient calculation in a one-dimensional pipe is presented. The transients are performed to achieve a steady-state condition . It is shown that by preserving the strong interdependence that exists between the hydraulic and thermal variables with an implicit flux treatment, it is possible to achieve a greater degree of numerical stability and in less computer time than with an explicit treatment. The method is slightly more complex but the large time step advantage more than pays for the overhead.

**34705** (NUREG/CP—0014(Vol.3), pp 2047-2063) **Parametric study of density-wave oscillation in evaporating tubes.** Nakanishi, S. (Osaka Univ., Japan); Ishigai, S.; Yamauchi, S. 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The effects of various parameters on the stability against the density-wave oscillation (including the flow excursion) in the evaporating tubes are analytically investigated over wide ranges by using Neimark's D-partition method. Then a convenient approximate method to construct the stability maps is developed, and finally general discussions on the effects of the parameters are given based on this method.

**34706** (NUREG/CP—0014(Vol.3), pp 2096-2111) **Flow of an incompressible fluid in interconnected parallel subchannels.** D'Arcy, D. (Atomic Energy of Canada Ltd., Chalk River, Ontario). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The flow of an isothermal liquid through two interconnected subchannels is examined. The conservation equations for the flow, developed elsewhere, are used to indicate the general nature of the subchannel flows. An example is worked out for a specific case for which experimental data are available. Good agreement with the experimental data is obtained using constant flow parameters. Typical values of these parameters are presented for the experimental case.

## 2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

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**34707 (EPRI—306-1) Multiple-cycle plutonium utilization nondestructive testing program. March 1972, March 1973, March 1974, and June 1974 Big Rock Point fuel inspection.** Crouthamel, C.E.; Wahlquist, F.P. (Exxon Nuclear Co., Inc., Richland, WA (USA). Research and Technology Center). Dec 1975. 126p. NTIS, PC A07/MF A01. Order Number DE82900137.

This is an interim report of the nondestructive testing program on the six (6) subassemblies comprising the Multiple Cycle Plutonium Utilization program. The subassemblies involved are two J-1 urania, two J-2 with islands of mixed oxide and two G-1 with islands of mixed oxide. All assemblies are being irradiated in the Big Rock Point Reactor of the Consumers Power Company.

**34708 (EPRI-NP—192) Mechanical fracture predictions for sensitized stainless steel piping with circumferential cracks.** Kanninen, M.F.; Broek, D.; Marschall, C.W.; Rybicki, E.F.; Sampath, S.G.; Simonen, F.A.; Wilkowski, G.M. (Battelle Columbus Labs., OH (USA)). Sep 1976. 180p. NTIS, PC A09/MF A01. Order Number DE82900115.

Circumferential intergranular stress corrosion cracks have been discovered in the heat-affected zones of girth welds in the Type 304 stainless steel recirculation bypass piping systems of several boiling water reactor (BWR) plants. These cracks initiate at the inner surface of the pipe wall and grow through the thickness by combined stress corrosion and fatigue. The work given in this report is based on the supposition that such a crack has been detected and that its size and shape are known. To determine the residual strength of the cracked pipe, an integrated program of small-scale laboratory experiments, full-scale pipe tests, finite-element computations, and a mechanical failure analysis was conducted. After investigating several candidates, the work has shown that a

simple plastic collapse criterion can most effectively be used to predict failure in Type 304 stainless steel pipes with circumferential cracks.

34709 **(EPRI-WS—79-174-Vol.1) Seminar on countermeasures for pipe cracking in BWRs.** (Electric Power Research Inst., Palo Alto, CA (USA)). May 1980. 567p. (CONF-800170—(Vol.1)). NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Intergranular stress corrosion cracking of welded type 304 stainless steel in the recirculation piping of boiling water reactors has had an impact on plant availability and reliability since the fall of 1974. Investigations of this problem have resulted in significant progress in understanding the phenomenon and providing an engineering resolution by developing and qualifying countermeasures. A number of these countermeasures including solution heat treatment, corrosion resistant clad, alternate pipe materials, induction heating stress improvement and heat sink welding have been implemented. Separate abstracts are included for each of the papers presented.

34710 (EPRI-WS—79-174-Vol.1, pp 31p, Paper 1) **Overview of intergranular stress corrosion cracking in BWRs.** Fox, M. (Electric Power Research Inst., Palo Alto, CA). May 1980. NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

In September of 1974, the Atomic Energy Commission ordered that 15 boiling water reactors (BWRs) be shut down to inspect 4-inch diameter bypass piping after small cracks had been found in similar piping at three other BWRs. In 1975 the newly formed Nuclear Regulatory Commission ordered that 23 BWRs again be shut down for inspection after cracking was discovered in larger, 10-inch diameter, piping. Sixty three incidents of pipe cracking were reported as of July 1975. The distribution of these incidents as a function of pipe diameter are presented through July 1978 and October 1979. Comparison of the 1975, 1978 and 1979 data shows that pipe cracking has continued to occur, and that larger diameter pipes are becoming affected. The cracking occurs predominantly in weld sensitized and furnace sensitized type 304 stainless steel and has been clearly identified as intergranular stress corrosion cracking (IGSCC). The simultaneous occurrence of three conditions are essential for IGSCC in BWRs: a critical level of stress (or stress intensity); a sensitized microstructure; and an environment that will facilitate IGSCC. Each essential condition and the remedies for pipe cracking that have been developed based on modifying each condition are presented.

34711 (EPRI-WS—79-174-Vol.1, pp 16p, Paper 2) **Overview of BWR pipe cracking in Japan.** Ando, Y. (Univ of Tokyo, Japan). May 1980. NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Outline of implementation of countermeasures for pipe cracking in Japanese BWR's are discussed in consideration of key factors of IGSCC in high temperature water environment. Experimental verification and stress analysis of Induction Heating Stress Improvement (IHSI), including the development of new FEM Code-FPAS are also discussed. R & D activities on instable failure of austenitic type 304 S.S., currently being performed in Japan, are presented.

34712 (EPRI-WS—79-174-Vol.1, pp 23p, Paper 3) **Models for the IGSCC of welded type 304 stainless steel piping in boiling water reactors.** Hanneman, R.E. (General Electric Corporate Research and Development Center, Schenectady, NY). May 1980. NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

This paper summarizes the key elements of models that describe the intergranular stress corrosion (IGSCC) process in the weld heat affected zones of type 304 stainless steel piping in boiling water (BWR) type environments. Both a film rupture model and a crevice chemistry model are treated. Factors affecting both the initiation and growth phases of the cracking process are assessed. The implications of these models to alleviate cracking in operating and future plants are also discussed.

34713 (EPRI-WS—79-174-Vol.1, pp 9p, Paper 4) **Solution heat treatment, corrosion resistant cladding and heat sink welding of type 304 stainless steel pipe welds.** Hughes, N. (General Electric Co., San Jose, CA). May 1980. NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Programs to identify the cause and mitigating methods for intergranular stress corrosion cracking (IGSCC) in weld heat-affected-zones of Type 304 Stainless Steel piping in Boiling Water Reactors (BWRs) have been underway for several years. In the present program three methods of mitigating IGSCC in Type 304 Stainless Steel are identified. Each of these techniques, Solution Heat Treatment, Corrosion Resistant Cladding and Heat Sink Welding address one or more of the coincident factors of high stress, weld-sensitization and oxidizing environment identified as the cause of IGSCC in the BWR. The practical considerations of each technique are addressed.

34714 (EPRI-WS—79-174-Vol.1, pp 27p, Paper 5) **Influence of carbon content on the ferrite morphology and the sensitization of duplex stainless steel.** Devine, T.M. (General Electric Co., Schenectady, NY). May 1980. NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

The influence of ferrite morphology and carbon content on the intergranular corrosion behavior of 308 stainless steel was investigated using 4 wrought alloys and 6 weld deposited alloys. The 4 wrought alloys were heat treated at 4 different annealing temperatures to introduce 4 different amounts of ferrite. The annealed samples along with the weld deposited alloys were aged in temperatures ranging from 480°C to 700°C for times varying between 1/4 and 1000 hours and then tested for intergranular corrosion susceptibility in acidified copper-copper sulfate solution. For a given carbon content there exists a critical amount and distribution of $\alpha$-$\gamma$ boundary area above which the alloy is immune and below which it is susceptible to intergranular corrosion. For amounts and distributions of $\alpha$-$\gamma$ boundary area less than the critical value two types of sensitization behavior are possible. A model is presented which describes as a function of carbon content the critical amounts and distributions of $\alpha$-$\gamma$ boundary area required for rapid healing and immunity to sensitization.

34715 (EPRI-WS—79-174-Vol.1, pp 8p, Paper 6) **Modeling of composition effects on the stress corrosion cracking of stainless steels.** Fullman, R.L. (General Electric Co., Schenectady, NY). May 1980. NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

The objective of this work is to advance present understanding of the influences of alloy composition on SCC and sensitization. The approach is to model the quantitative effects expected from individual constituents, and to test the results against available quantitative or qualitative data. Initial focus of the validation testing has been comparison to the empirical relationship between effective chromium concentration and effective carbon concentration suggested by Cihal.

34716 (EPRI-WS—79-174-Vol.1, pp 17p, Paper 7 ) **Technical considerations for startup deaeration procedures to minimize stress corrosion cracking of 304 stainless steel piping.** Andersen, P.L.; Ford, F.P. (General Electric Co., Schenectady, NY). May 1980. NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

BWR pipe cracking incidents result from an unfortunate combination of material, environment and stress states. This paper identifies the conditions which exist during startup and result in an

enhanced susceptibility to crack initiation and propagation; describes the effects of water chemistry, temperature and loading patterns on crack propagation; summarizes a mechanistic framework within which these effects can be understood and predicted; and finally indicates the means by which deaerated procedures can mitigate cracking. A summary of future research efforts will be given.

34717 (EPRI-WS—79-174-Vol.1, pp 24p, Paper 8) **Corrosion resistant cladding as an intergranular stress corrosion cracking countermeasure.** Tanaka, A.; Umemoto, T.; Kume, R. (Ishikawajima-Harima Heavy Industries Co., Ltd., Yokohama, Japan). May 1980. NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

For several years now, most boiling water reactors have been forced to run at a low availability as the intergranular stress corrosion cracking (IGSCC) at the weld heat-affected zones of type 304 austenitic stainless steel pipings was found. IGSCC occurs if stress (residual stress due to welding, operating stress etc.), material condition (sensitization due to welding, content of alloying elements etc.) and environmental factor (dissolved oxygen in reactor coolant, corrosion products etc.) exceed the threshold simulataneously. Many researchers and engineers have so far tried various measures to solve these problems. The corrosion resistant cladding (CRC) process introduced here is a method of cladding with weld deposited metal (buttering material) the pipe inner walls which are sensitized owing to the welding of joints, and consequently improving the SCC-resistance. The results of buttering material screening tests and the demonstration tests on 4B and 8B pipes used in actual plants are also reported.

34718 (EPRI-WS—79-174-Vol.1, pp 44p, Paper 9) **Mitigation of inside surface residual stress of type 304 stainless steel pipe welds by inside water cooling method.** Sasaki, R. (Hitachi Research Lab., Ibaraki-Ken, Japan);Masaoka, S.; Kirihara, K.I.; Itow, H.; Koyama, T.; Maruyama, T. May 1980. NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

The weld residual stress distributions, macro- and microstructures of heat affected zone and IGSCC susceptibility of Type 304 stainless steel pipe welds by natural and inside water cooling methods have been investigated. The residual stresses of pipe welds by the natural cooling method are high tensile on both the inside and the outside surface. While the residual stresses on the inside surface of pipe welds by the inside water cooling method are compressive in both axial and circumferential directions for each pipe size from 2 to 24 inch diameter. The sensitized zones of welds by the inside water cooling method are closer to the fusion line, much narrower and milder than those by the natural cooling method. According to the constant extension rate test results for specimens taken from the inside surface of pipe welds, the inside water cooled welds are more resistant to IGSCC than naturally cooled ones.

34719 (EPRI-WS—79-174-Vol.1, pp 35p, Paper 10) **Induction heating stress improvement for welded pipe and its effectiveness.** Shimizu, T.; Enomoto, K.; Araki, S.; Ikegami, T. (Hitachi Research Lab., Ibaraki-Ken, Japan). May 1980. NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

In order to eliminate tensile residual stresses near the weld heat affected zone on the inner surface of Type 304 stainless steel pipe welds in nuclear plants, the induction heating stress improvement (IHSI) method, in which the outside wall of a pipe is heated by an induction current while the inside surface of the pipe is cooled with water, has been investigated analytically and experimentally. The effectiveness of the IHSI method and its applicability to various pipes in actual plants have been proved. This method has also been found to be effective in reducing the fatigue crack propagation rate of cracks in precracked pipes under the repeated loading associated with plant operation.

34720 (EPRI-WS—79-174-Vol.1, pp 50p, Paper 11) **Actual proof test of IHSI for large diameter pipe.** Ohki, N. (Tokyo Electric Power Co., Inc., Japan); Araki, M.; Wakasa, K.; Nakayama, S.; Tanaka, A. May 1980. NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

IHSI (Induction heating stress improvement) technique which improves the residual stress at pipe inside surface was established and applied already to PLR riser piping. The essential variables (key Parameters) were determined. Keeping the essential variables in those control ranges, the effectiveness of IHSI can be promising. Actual proof test of IHSI application for large diameter piping was performed to show that IHSI was effective for large diameter pipings. Three large piping mock-ups were made after BWR PLR (Primary loop recirculation) piping.

34721 (EPRI-WS—79-174-Vol.1, pp 25p, Paper 12) **Analytical studies on IHSI for pre-cracked pipe.** Yagawa, G. (Univ. of Tokyo, Japan); Hayase, Y.; Shimizu, T.; Sakaguchi, Y.; Nakayama, S.; Umemoto, T. May 1980. NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

The induction heating stress improvement (IHSI) appears to be one of the most effective countermeasures for the intergranular stress corrosion cracking (IGSCC) of BWR piping after or under construction. It is worried in the method that there may be such small IGSCC as is not detectable by ultrasonic examination before application of the IHSI when the plant has been operated for a long time. Several calculations were performed using the finite element method (FEM) in order to show that: such a small crack does not extend during operation of the IHSI; and compressive residual stresses remain at the crack tip after operation of IHSI.

34722 (EPRI-WS—79-174-Vol.1, pp 51p, Paper 13) **Residual stress improvement by means of induction heating.** Tanaka, S.; Umemoto, T. (Ishikawajima-Harima Heavy Industries Co., Ltd., Yokohama, Japan). May 1980. NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

The intergranular stress corrosion cracking (IGSCC) of austenitic stainless steel is considered to occur when the three factors, material sensitization, tensile stress and environment condition, exceeds some threshold simultaneously. As to the tensile stresses, it is considered that the weld residual stress is one of the most important factors. The newly developed technique, Induction Heating Stress Improvement (IHSI) is intended to lower the tensile weld residual stress in the inner surface of the pipe. Many basic experiments and full-sized mock-up test on the actual austenitic stainless steel pipes; 4 in., 10 in., and 12 in., and calculations using finite element technique were conducted in order to find out appropriate heating conditions and verify the effectiveness of IHSI. As the results, the key parameters which have significant effects on IHSI results were determined.

34723 (EPRI-WS—79-174-Vol.1, pp 8p, Paper 14) **Applications of computational models for controlling weld residual stresses in BWR piping.** Rybicki, E.F. (Univ. of Tulsa, OK); McGuire, P.A.; Stonesifer, R.B.; Brust, F.W. May 1980. NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

This study describes the role of computational modeling in reaching the objective of controlling residual stresses in girth welded BWR pipes. The term computational model refers to a mathematical representation of the pipe geometry and the parameters of the welding process. The model represents the laws of solid mechanics and heat transfer. The output of the model is a prediction of the residual stresses, strains and deformations of the pipe for the particular pipe geometry and welding process being represented. The computational model is viewed as one tool to be used in evaluating and identifying ways to control residual stresses due to welding. The approach advocated here is to coordinate the compu-

tational modeling efforts with experimental studies for determining residual stresses.

34724 (EPRI-WS—79-174-Vol.1, pp 31p, Paper 15) **Statistical approach to qualify countermeasures.** Post, R. (San Jose State Univ., CA); Lemaire, J.; Walker, W. May 1980. NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Statistical methods used by General Electric Company under EPRI sponsorship in establishing goals for the durations of rigorous tests performed on nuclear reactor plant materials and materials processes are described. Tests consist of high temperature oxygen enriched water exposure under conditions which lead to intergranular stress corrosion in reference materials. Through the assumption of log normal failure distributions, methods are developed to define with statistical confidence test targets for successful testing of improved materials, and processes which provide high assurance of successful field performance throughout design life. Methods are proposed for tests comparing one heat of material under reference and remedied conditions, and for tests comparing the behavior of many heats of reference and alternate materials. Example calculations are provided based on data obtained from environmental tests.

34725 (EPRI-WS—79-174-Vol.1, pp 53p, Paper 16) **Induction heating stress improvement qualification.** Bertossa, D.C. (General Electric Co., San Jose, CA). May 1980. NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

The Induction Heating Stress Improvement (IHSI) process addresses the problem of intergranular stress corrosion cracking (IGSCC) in Type 304 Stainless Steel piping weld heat affected zones. Improved resistance is developed by producing compressive residual stresses at the surface in contact with the BWR water environment. Testing of reference and IHSI treated specimens is in progress. Both experimental and analytical methods have been employed. Two induction heat treating facilities were set-up and IHSI process parameters were optimized. The resulting procedures were used to treat pipe weldments of varying diameters for experimental evaluations. All IHSI treatments on test specimens are complete and the facilities have been dismantled.

34726 (EPRI-WS—79-174-Vol.1, pp 38p, Paper 17) **Qualification of solution heat treatment, corrosion resistant cladding and heat sink welding.** Hughes, N. (General Electric Co., San Jose, CA). May 1980. NTIS, PC A24/MF A01. Order Number DE82900054.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Full-size welded pipe statistical tests have been conducted to evaluate the improvement in intergranular stress corrosion cracking resistance of four piping remedies. These methods, which are compared to reference type 304 stainless steel, include solution heat treatment after butt welding, two techniques for application of a corrosion resistant cladding to the pipe inside surface, and heat sink welding. Factors of improvement are reported for each remedy. Failure analysis results are included.

34727 **(EPRI-WS—79-174-Vol.2) Seminar on countermeasures for pipe cracking in BWRs.** (Electric Power Research Inst., Palo Alto, CA (USA)). May 1980. 435p. (CONF-800170—(Vol.2)). NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Intergranular stress corrosion cracking of welded type 304 stainless steel in the recirculation piping of boiling water reactors has had an impact on plant availability and reliability since the fall of 1974. Investigtions of this problem have resulted in significant progress in understanding the phenomenon and providing an engineering resolution by developing and qualifying countermeasures. A number of these countermeasures including solution heat treatment, corrosion resistant clad, alternate pipe materials, induction heating stress improvement and heat sink welding have been implemented. Separate abstracts are included for each of the papers presented.

34728 (EPRI-WS—79-174-Vol.2, pp 40p, Paper 18) **EPRI's BWR piping integrity analysis program.** Jones, R.L.; Lapides, M.E. May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Intergranular stress corrosion cracking (IGSCC) in boiling water reactor (BWR) piping was initially observed at Dresden Unit 1 in the mid-1960's, but it was not until the fall of 1974 that the widespread nature of the problem was realized. The overall goal of the Program is to help maintain and improve the availability and reliability of operating and new BWR plants by extending the service lifetime of recirculation system piping and by minimizing outage times required for inspection and repair of this piping system. The objectives of the Problem Resolution phase of the program are to develop an improved capability for identifying those welds that are most probable to suffer IGSCC and for detecting cracks if they form; to provide reliable methods for predicting and monitoring crack growth; and to generate a credible evaluation of the consequences of cracking from a system viewpoint.

34729 (EPRI-WS—79-174-Vol.2, pp 12p, Paper 19) **Crack growth and detectability models of integrity of sensitized BWR piping welds.** Harris, D.O. (Science Applications, Inc., Palo Alto, CA). May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

A model for predicting the probability of failure of sensitized BWR piping welds is briefly described and applied to the assessment of the effectiveness of induction heating stress improvement (IHSI) in increasing the integrity of such welds. The model combines fracture mechanics calculations of subcritical and catastrophic crack growth with estimates of the size distribution of initial defects in order to provide information on the probability of failure of the weld as a function of time. The influence of inspections on the piping integrity are accounted for. Results are presented, using best estimates of the input parameters to the model, for the cases of as-welded and post-IHSI residual stresses in combination with a representative applied stress. The case of only a pre-service examination is considered.

34730 (EPRI-WS—79-174-Vol.2, pp 21p, Paper 20) **Critical strength of reactor coolant pipe with a surface flaw by stress corrosion cracking.** Kashima, K.; Tomoda, Y. (Central Research Inst. of Electric Power Industry, Tokyo, Japan). May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Circumferential stress corrosion crackings (SCC) have been discovered in type 304 stainless steel piping of the BWR primary coolant systems. It is important to estimate the strength of a cracked pipe in order to maintain the reliability of the reactor piping systems. This report describes some estimates of the effects of SCC on the strength of the pipe.

34731 (EPRI-WS—79-174-Vol.2, pp 22p, Paper 21) **Residual stress measurements on type 304 stainless steel welded pipes.** Chrenko, R.M. (General Electric Co., Schenectady, NY). May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

One factor considered responsible for stress corrosion cracking near type 304 austenitic stainless steel welds is the tensile stress to which the material is subjected while in use. This stress is a combination of the applied and the residual stresses and it is the residual stress that will be described. The axial ID residual stress near conventional welds in schedule 80 austenitic stainless steel pipes is usually tensile. Several methods have been developed which will substantially reduce these tensile stresses or induce compressive stresses. Residual stress results will be presented for austenitic stainless steel pipes that have conventional welds and heat sink welds, and for pipes that have been given induction heating and backlay treatments after a conventional weld. Some residual stress techniques, their applications, and limitations will also be discussed.

34732 (EPRI-WS—79-174-Vol.2, pp 23p, Paper 22) **Measured residual stresses in type 304 stainless steel piping butt weldments.** Shack, W.J.; Ellingson, W.A. (Argonne National Lab., IL). May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Residual-stress measurements on Type 304 stainless steel Schedule 80 4-, 10-, and 26-in. pipe weldments are presented. Both strain-gauge and x-ray diffraction techniques have been used. The bulk of the measurements have been made on the inner surface, since these stress levels presumably control the initiation of intergranular stress-corrosion cracking. Complete stress profiles have also been obtained through the thickness of the pipe wall, since the throughwall distribution controls the growth of a crack once it has initiated.

34733 (EPRI-WS—79-174-Vol.2, pp 13p, Paper 23) **Advanced methodology and instrumentation for x-ray stress analysis inside of piping.** Ruud, C.O. (Pennsylvania State Univ., University Park). May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

The x-ray diffraction method is the only time-proven, truly non-destructive method for the measurement of residual stresses. Proof of its reliability lies in documentation of its use by thousands of engineers and scientists over the past two decades. These applications have spanned from stress analysis of uranium/zirconium fuel rods of aluminum-alloy landing-gear components, and have included measurement of stresses in metal-powder-doped polymeric materials and tempering evaluation of carburized steels. The Society of Automotive Engineers considers the method of sufficient practical importance to have printed a Handbook Supplement on the subject three times. A very compact, highly versatile position-sensitive x-ray detector is described.

34734 (EPRI-WS—79-174-Vol.2, pp 21p, Paper 24) **Weld sensitization.** Solomon, H.D. (General Electric Co., Schenectady, NY). May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Stainless steels can be made sensitive to grain boundary attack in certain media. This sensitization results from the grain boundary chromium depletion that is caused by grain boundary precipitation of chromium carbides. Sensitization can be produced by isothermally heating and holding a stainless steel in the temperature range in which carbide precipitation is both thermodynamically and kinetically possible (i.e., 450 to 850°C for an austenitic stainless steel). It can also be produced by cooling through this sensitization range. It is this latter sort of thermal cycle that a weld heat affected zone (HAZ) experiences. This paper summarizes the results of recent studies of the variables which influence weld sensitization. Also summarized are recent calculations of the cooling rate experienced in the weld HAZ as a function of heat input and plate thickness. Correlations are also made between the material variables influencing sensitization and the welding variables.

34735 (EPRI-WS—79-174-Vol.2, pp 9p, Paper 25) **Microstructural investigations of low temperature sensitization in 304 stainless steel.** Morris, W.G.; Ritter, A.M. (General Electric Co., Schenectady, NY). May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Microstructural analyses have been performed on two welds in 304SS pipe, one in the as-welded condition and the other having seen two years of service at 288°C in a boiling water reactor. Comparison of the microstructures in the two weld heat affected zones indicates that low temperature sensitization appears to have taken place. Additional carbide formation, chromium depletion in grain boundaries, and susceptibility to attack by oxalic acid are observed in a region beyond 4 mm from the weld fusion line on the service sample.

34736 (EPRI-WS—79-174-Vol.2, pp 13p, Paper 26) **Predictability of low temperature sensitization in stainless steels.** Fullman, R.L. (General Electric Co., Schenectady, NY). May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

The term sensitization denotes development, as a result of thermal-exposure, of carbide precipitation and a resultant susceptibility to stress corrosion cracking. In stainless steels, a variety of metallurgical changes have been suggested as mechanisms for sensitization, but it is generally accepted that sensitization occurs most commonly by chromium depletion adjacent to chromium-rich carbides precipitated at grain boundaries.

34737 (EPRI-WS—79-174-Vol.2, pp 21p, Paper 27) **Effects of grain boundary impurities and cold work on the corrosion of 304 stainless steel.** Briant, C.L. (General Electric Co., Schenectady, NY). May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

This paper reports on studies of heat to heat variability in 304 stainless steels. It shows that nitrogen may retard the nucleation of $Cr_{23}C_6$ and thus deter the sensitization process. At high electrochemical potentials phosphorus can accelerate the corrosion of a sensitized sample. The presence of martensite greatly increases the kinetics of chromium depletion and thus provides a mechanism for rapid sensitization.

34738 (EPRI-WS—79-174-Vol.2, pp 36p, Paper 28) **Evaluation of SCC susceptibility for sensitized 304 stainless steel by means of cyclic tension rate in 290°C high purity water.** Takaku, H.; Tokiwai, M.; Hirano, H. (Central Research Inst. of Electric Power Industry, Tokyo, Japan). May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

The effects of load waveform on intergranular stress corrosion cracking (IGSCC) susceptibility have been examined for sensitized 304 stainless steels in a 290°C high purity water loop. Concerning the strain rate in the trapezoidal stress waveform, it was found that IGSCC susceptibility was higher for smaller values of the strain rate. The following were also proved that IGSCC susceptibility became higher when the holding time at the upper stress was prolonged and when the upper stress level was raised. The occurrence of IGSCC for sensitized 304 stainless steel was extremely facilitated by loading of the cyclic tension in 290°C high purity water.

34739 (EPRI-WS—79-174-Vol.2, pp 25p, Paper 29) **EPR method for the detection of sensitization in stainless steels.** Clarke, W.L.; Cowan, R.L. May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

The overall objective of the program was to improve the reliability of reactor system piping by increasing knowledge of failure causing mechanisms and by enhancing the capability for design evaluation and analysis. Toward the attainment of that objective, a technique has been developed to measure the degree of sensitization quantitatively in thermally treated AISI-304, -304L, -316 and 316L stainless steels. The Electrochemical Potentiokinetic Reactivation (EPR) test was developed because of an industrial need for a rapid, nondestructive, quantitative field test which could be used for assessing sensitization in reactor components. The EPR method consists of developing potentiokinetic curves on a polarized sample obtained by controlled potential sweep from the passive to the active region (reactivation) in a specific electrolyte; details of the test technique have been reported.

34740 (EPRI-WS—79-174-Vol.2, pp 25p, Paper 30) **Stress corrosion cracking of sensitized Type 304 stainless steel under cyclic load.** Berry, W.E.; White, E.L.; Payer, J.H. (Battelle Columbus Labs., OH). May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

In connection with boiling-water reactor (BWR) applications, it has been well documented that both weld-sensitized and furnace-sensitized Type 304 stainless steel exhibit stress-corrosion cracking (SCC) in oxygenated high-temperature water. In addition, long term low-temperature sensitization such as might occur at BWR operating conditions (288 C) appears to increase SCC susceptibility. Experimental studies have produced SCC in weld sensitized stainless steel at static and cyclic stresses in excess of the yield strength and in slow strain rate tests. However, these conditions of plastic strain are unduly severe and it can be argued that they are not characteristic of BWR operating conditions. Work conducted at Battelle's Columbus Laboratories in non-nuclear related programs has shown that small incremental cyclic loading at mean stresses less than 50 percent of yield strength will produce SCC of line pipe steel IN $Na_2CO_3$ - IN $NaHCO_3$ solutions providing the cycle is extremely slow say less than once per day. It can be expected that similar effects may be operative in BWR applications where small cyclic loads also may occur.

34741 (EPRI-WS—79-174-Vol.2, pp 15p, Paper 31) **Method for monitoring crack growth from flaws in piping and other components.** Catlin, W.R.; Morgan, H.M.; Lord, D.C.; Coffin, L.F. (General Electric Co., Schenectady, NY). May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

A status report on a program to evaluate predefected component performance in oxygenated high temperature water is presented. Defects more severe than natural defects introduced by primary processing and fabrication are to be monitored for crack growth during component testing and the results compared with life prediction procedures. Evaluation of various crack growth measurement procedures are discussed. A crack growth monitoring technique using reversed DC electric potential measurement and its implementation by a microprocessor controlled readout system are described. Plans for implementing the technique into the General Electric Co.'s Pipe Test Laboratory are reviewed.

34742 (EPRI-WS—79-174-Vol.2, pp 10p, Paper 32) **Effect of oxidizing species on SCC on 304 stainless steel and alternative water chemistry.** Hirano, H.; Mizuno, T.; Aoki, N.; Kurosawa, T. (Central Research Inst. of Electric Power Industry, Tokyo, Japan). May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

This paper describes the effect of oxygen on IGSCC and the possibility of reduction of oxidizing species. Oxygen accelerated the intergranular corrosion of sensitized Type 304 stainless steel and the dissolution of chromium from the protective oxide film of the steel. Hydrazine injection method is proposed as an alternative water chemistry during normal load operation. The prospects for this method and the points at issue is discussed, comparing with a hydrogen injection method and an ammonium method.

34743 (EPRI-WS—79-174-Vol.2, pp 13p, Paper 33) **Effects of pH and applied potential on stress corrosion cracking susceptibility of sensitized Type 304 stainless steel in dilute $Na_2SO_4$ solution at 285°C.** Fukuzuka, T.; Shimogori, K.; Fujiwara, K.; Tomari, H. (Kobe Steel, Ltd., Japan). May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Since the trouble of IGSCC in the primary water piping made of Type 304SS occurred in the BWR nuclear power plant, a lot of work has been carried out on the SCC of stainless steels in high temperature deionized water. It has been made clear from these works that the IGSCC is caused by a combination of three interdependent parameters: chromium depletion accompanied with precipitation of chromium carbides along the grain boundaries by the thermal histories during welding, total applied and residual stresses, and dissolved oxygen of the environment.

34744 (EPRI-WS—79-174-Vol.2, pp 27p, Paper 34) **Examination of pipe weld specimens removed from service.** Pasupathi, V.; Perrin, J.S.; Berry, W.E.; Steigelmeyer, W.N. (Battelle Columbus Labs., OH). May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Intergranular stress corrosion cracking (IGSCC) of welded type 304 stainless steel BWR piping has caused a great deal of concern to the electric power industry. The cracking initiated on the inside surface has been located in weld heat affected zones, and is known to be influenced by local conditions of stress, environment, and metallurgical condition. Each of these three general parameters is known to vary within certain bounds. If critical conditions of overlap occur, cracking takes place. Research on this phenomenon has resulted in a workable understanding of the many complex interrelationships.

34745 (EPRI-WS—79-174-Vol.2, pp 33p, Paper 35) **Finite element stress analysis of 4-inch diameter welded pipe with prescribed residual stresses.** Derbalian, G. (Failure Analysis Associates, Palo Alto, CA); Egan, G.R.; Aboim-Costa, C. May 1980. NTIS, PC A19/MF A01. Order Number DE82900053.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

This report summarizes results obtained from the finite element analysis of a four inch diameter welded pipe under residual stress and a uniform axial tensile load of up to 1.36 times the yield stress of the base metal (pipe). Different weld root geometries (drop through and suck up) and different residual stress distributions in the weld metal and heat affected zone (HAZ) were considered. It is concluded that at 136% yield load the entire pipe yields. However, at 105% yield load the HAZ is only partially plastic adjacent to the base metal and furthermore the weld metal is elastic. At operating loads (14 ksi tensile load) the combined axial stresses in the HAZ are tensile (i.e., compressive residual stresses are overcome by the applied tension) hence increasing the propensity for cracking. Yielding commences in the pipe at about the level of operating loads. Different weld root geometries (drop through and suck up) and a pipe with and without weld crown were compared. Differences in stress redistribution were insignificant.

34746 **(EPRI-WS—79-174-Vol.3) Seminar on countermeasures for pipe cracking in BWRs.** (Electric Power Research Inst., Palo Alto, CA (USA)). May 1980. 301p. (CONF-800170—(Vol.3)). NTIS, PC A14/MF A01. Order Number DE82900056.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Intergranular stress corrosion cracking of welded type 304 stainless steel in the recirculation piping of boiling water reactors has had an impact on plant availability and reliability since the fall of 1974. Investigations of this problem have resulted in significant progress in understanding the phenomenon and providing an engineering resolution by developing and qualifying countermeasures. A number of these countermeasures including solution heat treatment, corrosion resistant clad, alternate pipe materials, induction heating stress improvement and heat sink welding have been implemented. Separate abstracts are included for each of the papers presented.

34747 (EPRI-WS—79-174-Vol.3, pp 18p, Paper 36) **Monitoring and control of oxygen in boiling water reactors.** Pearl, W.L.; Kassen, W.R.; Leibovitz, J.; Sawochka, S.G. (NWT Corp., San Jose, CA). May 1980. NTIS, PC A14/MF A01. Order Number DE82900056.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Recurring cases of intergranular stress corrosion cracking (IGSCC) in some stainless steel piping systems in boiling water reactors (BWRs) have been a concern to the nuclear power industry. Extensive research has shown that three factors must be considered in evaluating occurrences of IGSCC: total local stress; sensitization of heat affected weld zones; and chemical species in the reactor water, such as oxygen and hydrogen peroxide. An extensive BWR site monitoring program (RP449-3) to quantify the third of these

factors, i.e., the variation of oxygen and hydrogen peroxide concentrations during steady-state and transient conditions in operating BWRs, has been performed recently under the auspices of the Electric Power Research Institute (EPRI) by NWT Corporation. Based partially on results of the monitoring program, EPRI sponsored additional work (RP706-1-2) with NWT to define and demonstrate means for reducing oxygen and hydrogen peroxide concentrations in reactor water during shutdown and startup transients.

34748 (EPRI-WS—79-174-Vol.3, pp 33p, Paper 37) **Deaerated startup operation as a countermeasure for BWR pipe cracking.** Kaikawa, K. (Chugoku Electric Power Co., Hiroshima-shi, Japan); Matsushima, Y.; Yonezawa, K.; Ohnaka, N.; Minato, A.; Ohsumi, K. May 1980. NTIS, PC A14/MF A01. Order Number DE82900056.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Reactor water quality during transient operations has been quantified at Shimane Nuclear Power Station. During shutdown and startup periods, oxygen and hydrogen peroxide were present at significant concentrations. Changes in other water chemistry parameters such as pH, conductivity and anion concentrations were also observed. Need for deaeration and its effectiveness as a countermeasure for BWR pipe cracking were evaluated using laboratory data on cracking. Deareated startup operations were proposed and demonstrated at Shimane. The best procedure for deaerated startup has been identified to reduce oxygen and hydrogen peroxide concentrations before and during heatup period.

34749 (EPRI-WS—79-174-Vol.3, pp 17p, Paper 38) **Model for intergranular stress corrosion cracking initiation in BWR pipes and the virtue of startup deaeration.** Kawakubo, T.; Hishida, M.; Arii, M. (Tokyo Shibaura Electric Co., Ltd., Japan). May 1980. NTIS, PC A14/MF A01. Order Number DE82900056.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Key factors conductive to IGSCC in high temperature water in both startup and stable operation are discussed. Also, several factors resulting from IGSCC incidents in field plants are pointed out. Based on these results, a model for IGSCC initiation in BWR pipes is presented. A series of BWR startup simulation tests were conducted using a flowing autoclave system with constant extension rate test equipment. Validity of the model is established by the test results. Based on the model, nitrogen strengthened Type 316 stainless steel with low carbon content and startup deaeration is effective in preventing IGSCC.

34750 (EPRI-WS—79-174-Vol.3, pp 15p, Paper 39) **Effects of surface preparation, stress and deaeration on the stress corrosion cracking of type 304 stainless steel in simulated BWR start-up cycles.** Andersen, P.L. (General Electric Co., Schenectady, NY). May 1980. NTIS, PC A14/MF A01. Order Number DE82900056.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

BWR start-up deaeration has attracted increasing interest during the last several years. The Swedish and Japanese have employed start-up deaeration, and domestic studies have correlated BWR pipe cracking incidents with the number of start-ups following shutdown for longer than 24 hours. While the potential benefits of start-up deaeration may seem obvious, the complexity of the interactions between changing temperature, environment, and stress preclude the drawing of simple, accurate predictions based on available data. This paper presents the results of a program which is studying the integrated effects of these variables as a function of surface condition, low temperature sensitization (LTS), deaeration procedure and stress level.

34751 (EPRI-WS—79-174-Vol.3, pp 36p, Paper 40) **Controlled potential simulation of deareated and nondeareated startup.** Indig, M.E. (General Electric Co., Pleasanton, CA). May 1980. NTIS, PC A14/MF A01. Order Number DE82900056.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

A laboratory program has been conducted to compare the environmental effect of deaerated and non-deaerated BWR startups on the mitigation of IGSCC on sensitized Type-304 stainless steel. The results of multiple cyclic testing by an electrochemical/mechanical method indicated that plant deaeration could significantly reduce the incidence of IGSCC during reactor startup. Reactor startup simulations and related straining electrode tests indicated that even in the deaerated cycle chosen, there were environmental regions of high susceptibility to IGSCC during the heatup period. Future testing with an improved deaeration cycle (containing shutdown/start-up $O_2/H_2O_2$ control) would probably be more effective in mitigating IGSCC.

34752 (EPRI-WS—79-174-Vol.3, pp 7p, Paper 41) **Methods of BWR deaeration.** Myers, W.G.; Elliott, J.C. (General Electric Co., San Jose, CA). May 1980. NTIS, PC A14/MF A01. Order Number DE82900056.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

The need for deaeration of BWR primary coolant exists primarily during plant transients, such as startups and shutdowns. For example, without shutdown deaeration and proper venting procedures, the high oxygen concentrations and stress conditions occurring during reactor startup favor the development of intergranular stress corrosion cracking of sensitized stainless steel materials. A BWR shutdown deaeration system recommended by General Electric is described.

34753 (EPRI-WS—79-174-Vol.3, pp 2p, Paper 42) **Decision analysis for boiling water reactor oxygen control.** Eason, E.D.; Brown, S.B.; Thomas, J.M. (Failure Analysis Associates, Palo Alto, CA). May 1980. NTIS, PC A14/MF A01. Order Number DE82900056.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

The project has three primary phases: development of a cracking incident data base, development of a decision model incorporating probable failure rates and life-cycle economic analysis, and execution of sensitivity studies. Several sensitivity studies are planned, measuring the effects of relative degree of material sensitization and uncertainties in failure rates after oxygen control, repair and replacement costs, and economic analysis parameters. These studies are expected to highlight critical data needs and help identify high payoff areas for additional research.

34754 (EPRI-WS—79-174-Vol.3, pp 27p, Paper 43) **Development of low carbon 316 stainless steel.** Kowaka, M.; Nagano, H.; Yoshikawa, K.; Miura, M.; Ohta, K.; Nagata, S. (Sumitomo Metal Industries, Ltd., Tokyo, Japan). May 1980. NTIS, PC A14/MF A01. Order Number DE82900056.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

This paper concerns the development of the nuclear grade 316 stainless steel as an alternative material of BWR pipings. Great emphasis is placed on the effect of nitrogen and molybdenum on IGSCC in high temperature water, sensitization strength and weldability. This steel, with carbon less than 0.02% and nitrogen of a maximum of 0.12% has excellent resistance to IGSCC in high temperature water. Its mechanical properties and weldability are as good as 316 stainless steel.

34755 (EPRI-WS—79-174-Vol.3, pp 49p, Paper 44) **Stress corrosion cracking resistance, mechanical properties and weldability of nuclear grade 316 stainless steel.** Kobayashi, T. (Tokyo Electric Power Co. Inc., Japan); Miyagawa, M.; Yoshida, T.; Hattori, S.; Hamada, I.; Okada, T.; Yoshida, K.; Nagata, S. May 1980. NTIS, PC A14/MF A01. Order Number DE81900056.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

A joint study has been performed on verification of the Nuclear Grade 316 stainless steel whose carbon content is less than 0.02% and nitrogen content is around 0.1%. Five heats of the steel conventionally manufactured as 4 ~ 24 inch diameter seamless pipes showed excellent resistance to sensitization and stress corrosion cracking in BWR related environment with various severe

conditions including severe sensitizing heat treatments, welding, repair welding, counterbore grinding, post weld heat treatments etc. The test results of mechanical properties and weldability have indicated no serious problem. In conclusion, the Nuclear Grade 316 stainless steel has been fully verified for actual use as a piping material of BWR.

34756 (EPRI-WS—79-174-Vol.3, pp 17) **Immunization of type 316 and 304 stainless steels to intergranular stress corrosion cracking by thermochanical treatment.** Kondo, T.; Kiuchi, K.; Tsuji, H. (Japan Atomic Energy Research Inst.,Ibaraki-ken). May 1980. NTIS, PC A14/MF A01. Order Number DE82900056.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Thermomechanical treatment associated with carbide stabilizing aging of cold worked material followed by recrystallization heating gave plain standard stainless steels substantial resistance to the intergranular corrosion and cracking in various test environments. IGSCC susceptibility tests on the so treated materials after giving a typical thermal history of simulated welding showed that the treatment worked satisfactorily in type 316 steel over wide range of conditions, while type 304 could be protected to only a limited extent with very closely controlled treatments. The response of the materials to the sensitizing heating in terms of impurity segregation at grainboundaries was also examined by means of microchemical analysis.

34757 (EPRI-WS—79-174-Vol.3, pp 20p, Paper 46) **Comparison of stress corrosion cracking susceptibility among several austenitic stainless steels in high temperature deionized water.** Fukuzuka, T.; Shimogori, K.; Fujiwara, K.; Tomari, H. (Kobe Steel Ltd., Japan). May 1980. NTIS, PC A14/MF A01. Order Number DE82900056.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

This paper presents the comparison of the IGSCC susceptibility in high temperature deionized water among several low carbon type austenitic stainless steels taken into consideration such means as mentioned above. The intergranular corrosion (IGC) susceptibility is also compared by modified Strauss and EPR tests, and then the correlation between the IGSCC susceptibility and the IGC susceptibility by the modified Strauss or the EPR tests is discussed.

34758 (EPRI-WS—79-174-Vol.3, pp 8p, Paper 47) **Production and implementation of nuclear grade stainless steel piping.** Copeland, J.F.; Lin, J.; Alexander, J.E.; Sayre, E.D. (General Electric Co., San Jose, CA). May 1980. NTIS, PC A14/MF A01. Order Number DE82900056.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

A large degree of interest in procuring low-carbon Type 316 stainless steel for BWR piping has been expressed. Such piping is procured to requirements which represent the state-of-the-art with regard to mitigating IGSCC in BWR aqueous environments. Considerable experience is being gained to verify that vendors have the capability to meet Nuclear Grade requirements for austenitic stainless steel piping components. Nuclear Grade specifications have been generated, based upon similar specifications used previously to successfully procure piping. Further vendor review and qualification is ongoing, along with continuous upgrading of requirements based upon experience and test program results.

34759 (EPRI-WS—79-174-Vol.3, pp 16p, Paper 48) **Alternate piping alloy qualification.** Alexander, J.E. (General Electric Co., San Jose, CA). May 1980. NTIS, PC A14/MF A01. Order Number DE82900056.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Intergranular stress corrosion cracking (IGSCC) of welded stainless steel piping in Boiling Water Reactors (BWRs), and more recently in Pressurized Water Reactors (PWRs), has been a problem of concern to the power generation industry. An effort to qualify alternate materials was instituted by General Electric and sponsored in part by the Electric Power Research Institute (EPRI) under joint GE/EPRI contract RP968-1. The EPRI-sponsored effort is a four-year program designed to qualify and implement into BWR service an alternate piping alloy that is not subject to intergranular stress corrosion cracking within the plant design lifetime. The program is described.

34760 (EPRI-WS—79-174-Vol.4) **Seminar on countermeasures for pipe cracking in BWRs.** (Electric Power Research Inst., Palo Alto, CA (USA)). May 1980. 277p. (CONF-800170—(Vol.4)). NTIS, PC A13/MF A01. Order Number DE82900055.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Intergranular stress corrosion cracking of welded type 304 stainless steel in the recirculation piping of boiling water reactors has had an impact on plant availability and reliability since the fall of 1974. Investigations of this problem have resulted in significant progress in understanding the phenomenon and providing an engineering resolution by developing and qualifying countermeasures. A number of these countermeasures including solution heat treatment, corrosion resistant clad, alternate pipe materials, induction heating stress improvement and heat sink welding have been implemented. Separate abstracts are included for each of the papers presented.

34761 (EPRI-WS—79-174-Vol.4, pp 13p, Paper 50) **TEPCO's approach to pipe cracking of BWRs.** Kojima, T. (Tokyo Electric Power Co., Japan). May 1980. NTIS, PC A13/MF A01. Order Number DE82900055.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Following the first occurrence of cracking in the stainless steel piping of the US plant in 1974, inspection disclosed crackings of the same type in the similar lines of Japanese BWR plants. Since it took a good amount of time for inspection of welds, repair of cracked parts and replacement of susceptible lines, availability factor of the BWR plants was low in the years of 1975 through 1977. This paper describes the approach to the pipe cracking problem that TEPCO has taken and the current status of the countermeasures.

34762 (EPRI-WS—79-174-Vol.4, pp 14p, Paper 51) **Countermeasures for BWR pipe cracking.** Higgins, J.P. (General Electric Co., San Jose, CA). May 1980. NTIS, PC A13/MF A01. Order Number DE82900055.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Occurrences of intergranular stress corrosion cracking (IGSCC) at weld heat-affected zones (HAZ's) of Type-304 stainless steel (S/S) pipe welds, although not a safety concern, have effected plant availability. These incidents of cracking (193 to date as shown in Table 1) have occurred in less than 1% of the total weld population in operating plants. A comprehensive program by General Electric (GE) with support from EPRI, has developed and qualified a variety of IGSCC countermeasures to mitigate these occurrences. This paper provides a listing of recommended actions and the implementation status of these countermeasures for all GE Boiling Water Reactors (BWR's).

34763 (EPRI-WS—79-174-Vol.4, pp 26p, Paper 52) **Induction heating stress improvement implementation to actual plants.** Futami, T. (Tokyo Electric Power Co., Inc., Japan); Matsumoto, T.; Iwasaki, S.; Umemoto, T. May 1980. NTIS, PC A13/MF A01. Order Number DE82900055.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

IHSI (Induction Heating Stress Improvement) is a countermeasure for IGSCC (Inter Granular Stress Corrosion Cracking) in BWR piping. This technique is specially effective for plants which have been constructed, because this method can be applicable without cutting or re-welding pipes. In Japan, IHSI was already qualified by regulatory authorities and was applied or is going to be applied to many actual plants. Based on the experience in Japan, the implementation method of the technique is explained.

34764 (EPRI-WS—79-174-Vol.4, pp 14p, Paper 53) **Oxygen control operation during BWR start-up period.** Ohki, N. (Tokyo Electric Power Co., Japan). May 1980. NTIS, PC A13/MF A01. Order Number DE82900055.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

As a part of SCC countermeasures, deaeration procedure and measurement results of oxygen concentration in reactor water during start-up operation of Japanese BWRs are discussed.

**34765** (EPRI-WS—79-174-Vol.4, pp 12p, Paper 54) **Deaeration practices in Swedish BWRs.** Fejes, P. (ASEA-ATOM, Vasteras, Sweden). May 1980. NTIS, PC A13/MF A01. Order Number DE82900055.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

The control of the concentration of dissolved oxygen in the reactor water during pre-nuclear hot test and before nuclear start-up has been a routine operation with the Swedish BWRs for almost ten years since the first test runs of the first Swedish BWR. During cold shut down the primary system is blanketed with nitrogen. During the yearly refuelling outage the reactor water is saturated with air. Before the start of nuclear heating of the reactor the oxygen is stripped of the ractor water by blowing nitrogen gas through the RPV. The Swedish BWRs have operated since the first start-up with oxygen addition to the feed water. In 1979 a chemical deaeration technique was successfully demonstrated in the 570 MWe Oskarshamn 2 BWR. The control of oxygen concentration of the primary water by addition of hydrogen to the coolant appears to be able to eliminate BWR IGSCC.

**34766** (EPRI-WS—79-174-Vol.4, pp 10p, Paper 55) **Nondestructive inspection methods for IGSCC in piping.** Rajala, B.R. (General Electric Co., San Jose, CA). May 1980. NTIS, PC A13/MF A01. Order Number DE82900055.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

This paper describes the manual ultrasonic examination method to be used on stainless steel piping to detect intergranular stress corrosion cracking (IGSCC). Included is a discussion of the scanning patterns, search units, calibration, recording, and personnel training requirements and a description of the most likely orientation and location of IGSCC at piping welds. The methods described will enable meeting the requirements recommended in Nuclear Regulatory Commisson (NRC) Pipe Crack Study Group (PCSG) Reports.

**34767** (EPRI-WS—79-174-Vol.4, pp 22p, Paper 56) **Ultrasonic testing for detection of intergranular stress corrosion cracking.** Kupperman, D.S. (Argonne National Lab., IL). May 1980. NTIS, PC A13/MF A01. Order Number DE82900055.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Beginning in the fall of 1974, numerous intergranular stress-corrosion cracks (IGSCC) have been found in the heat-affected zone (HAZ) of welded Type 304 stainless steel reactor piping. As a result of these findings, a 2-year program sponsored by EPRI was initiated at Argonne National Laboratory (ANL) in 1975 to help establish the adequacy of conventional ultrasonic-testing techniques for the detection of IGSCC. This paper discusses the quantitative data describing the effect of transducer parameter variations on ultrasonic echo amplitude from a variety of artificial and natural reflectors and gives suggestions for improvements in ultrsonic in-service testing methods, including the use of focussed probes. The effect of variation in ultrasonic attenuation between HAZ and base metal, the importance of adequate reference standards, and geometric effects are also discussed, and recent efforts at ANL and other institutions to improve ultrasonic detection of cracks are reviewed.

**34768** (EPRI-WS—79-174-Vol.4, pp 13p, Paper 57) **Overview of EPRI Ultrasonic Test (UT) development program.** Dau, G.J.; Lapides, M.E. (Electric Power Research Inst., Palo Alto, CA). May 1980. NTIS, PC A13/MF A01. Order Number DE82900055.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

The EPRI Ultrasonic Test (UT) Development Program, initiated in 1975, has been oriented to the requirements of in-service detection of intergranular stress corrosion cracking (IGSCC) in type 304 stainless steel piping in boiling water reactors (BWR), and has grown from that base to address similar or related problems in alternate nuclear generation units. The latter include feedwater nozzles, cast austenitic piping, bi- and tri-metallic welds, pump and valve bodies and pipe repairs. In addition, the UT techniques are being adapted to on-line surveillance of detected flaws.

**34769** (EPRI-WS—79-174-Vol.4, pp 18p, Paper 58) **Contingency programs for BWR pipe cracking.** Marguin, J.J.; Hamilton, R.B. (General Electric Co., San Jose, CA). May 1980. NTIS, PC A13/MF A01. Order Number DE82900055.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

General Electric (GE) has aggressively addressed the problem of Intergranular Stress Corrosion Cracking (IGSCC). Intergranular Stress Corrosion Cracking has occurred in boiling water reactors in less than 1% of the Type-304 stainless steel welds in operating plants. However a comprehensive program by GE, with EPRI support in many cases, has provided technical solutions to limit IGSCC. As part of this program the Nuclear Services Department (NSD) has taken new technology and applied it to programs for the prevention of IGSCC and for repair of pipe cracks should they occur. The purpose of this paper is to provide a description and the current status of the major ongoing service programs for dealing with the problems related to IGSCC in BWR operating plants.

**34770** (EPRI-WS—79-174-Vol.4, pp 29p, Paper 60) **Development and application of remote-controlled automatic pipe welding machine with TV camera for stress corrosion cracking remedy works.** Tamai, Y.; Iwama, T.; Matsumoto, T.; Koyama, T.; Kokura, S. (Hitachi, Ltd., Ibaraki-Ken, Japan). May 1980. NTIS, PC A13/MF A01. Order Number DE82900055.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Hitachi developed the remote-controlled automatic gas tungsten arc welding machine in order to apply to the stress corrosion cracking remedy works of the existing Type 304 stainless steel piping, which was revealed the occurrence or the possibility of the stress corrosion cracking. This remote-controlled welding machine has been applied to some existing plants for the above purpose. Much reduction of welders' radiation exposure has been achieved by this remote-controlled welding machine comparing with the conventional manual welding method.

**34771** (EPRI-WS—79-174-Vol.4, pp 32p, Paper 61) **Plans for repair of Garigliano BWR.** D'Anna, C.; Sica, G.F. (Ente Nazionale per l'Energia Elettrica, Rome, Italy). May 1980. NTIS, PC A13/MF A01. Order Number DE82900055.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

This paper presents a description of the major activities to be performed at Garigliano Nuclear Power Station to by-pass both steam generators (SSG) including removal of existing piping and installation of by-pass piping. Also presented is a determination of the SSG failure mechanism and the performing of an inservice inspection (ISI) on the primary system.

**34772** **(NEDC—12705-3) Dilute chemical decontamination program. Quarterly report No. 3, April 1-June 30, 1978.** Anstine, L.D. (Commonwealth Research Corp., Chicago, IL (USA)). Nov 1978. Contract AC02-76ET34203. 38p. NTIS, PC A03/MF A01. Order Number DE81028509.

Decontamination procedures for BWR type reactors are studied concerning solvent evaluation and selection, and corrosion of reactor steels.

**34773** (NUREG/CP—0014(Vol.1), pp 155-173c) **State of the art of thermal-hydraulics of BWRs.** Zia Rouhani, S. (EG & G Idaho, Inc., Idaho Falls). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The general field of thermal-hydraulics of boiling water reactors (BWRs) is very vast and includes not only treatment of the core and flows inside the reactor vessel, but also, flows through the turbine, reheaters condensors, preheaters, auxiliary systems and, particularly, the very important aspects of transients inside all these systems as well as in the pressure-suppression and containment system. However, for practical reasons, the present discussion will be limited only to the thermal-hydraulic aspects inside the core and main vessel of BWRs.

34774 (NUREG/CP—0014(Vol.1), pp 192-203) **Thermal-hydraulic effects on power distributions in boiling water reactors.** Simonson, S.C. III (Nuclear Associates International, Sunnyvale, CA); Richmond, M.A. 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The effects on power distributions of variations in thermal-hydraulic models and input parameters were studied using the EPRI-THERM-B and EPRI-NODE-B codes for BWRs. The effect of model void profiles was considered by comparing the original model with a model characterized by earlier voiding. For quantitative analysis, relations were developed between the distributions of power and moderator density. Sensitivity studies using typical bounds on uncertainties in input parameters resulted in power distribution changes of +- 2% to +- 5%. Alternative models differed in their responses enough to be significant in the analysis of transients.

34775 (NUREG/CP—0014(Vol.1), pp 204-220) **Experimental determination of local steam velocities and boiling boundaries in a BWR.** Gebureck, P.; Ceelen, D.; Grondey, J.; Stegemann, D. (Univ. of Hannover, Germany). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Movable assemblies of self-powered neutron detectors were used for stationary as well as for noise measurements in the core of a BWR. Boiling Boundaries and space-dependent steam bubble velocities were evaluated for different reactor operating conditions by means of correlation and spectrum analysis methods. The results are compared to thermal hydraulic computations of the two-phase flow. Basing upon these experiences, an on-line system for the surveillance of thermal hydraulic characteristics in a boiling water reactor core was developed including options for monitoring mechanical behavior and vibrations of structures.

34776 (NUREG/CP—0014(Vol.1), pp 241-256) **Application of the ejector principle for thermal protection of the feedwater nozzles in ASEA-ATOM BWRs.** Schoelin, B.; Borrman, B.; Mansson, R. (ASEA-ATOM AB, Vaesteraas, Sweden). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The ejector principle, as applied to thermal protection of the feedwater nozzles in ASEA-ATOM BWRs, is described. Full scale laboratory tests confirming the applicability are reported. In-reactor measurements are presented, demonstrating that the ejector principle can provide satisfactory thermal protection of the feedwater nozzles during reactor operation. The significance, as regards pressure drop and thermal cycling, of a well rounded inlet for the discharge holes of the feedwater sparger is illustrated by results from a comprehensive laboratory test program.

34777 (NUREG/CP—0014(Vol.1), pp 535-564) **Mathematical model for analysis of the hydraulic performance of cyclone-type steam separators.** Rouhani, S.Z. (EG & G Idaho, Inc., Idaho Falls). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

After defining the geometry and flows in different parts of an upcomer separator, some procedures for estimating local void fraction and pressure drop in the different parts are formulated. Special approaches are used: (a) for calculating vapor volume fraction at the inlet to the separator cylinder, the vortex radius near the liquid outlet, and the necessary separation length; and (b) for the evaluation of flow resistance coefficients at the mixture inlet and at the liquid outlet. The essential point of obtaining a proper balance between the pressure drops over the separate outlets for vapor and liquid is explained, and the factors which influence this balance are clarified.

34778 (NUREG/CP—0014(Vol.1), pp 774-797) **Vibration-induced instabilities in turbulent flow near the wall.** Arienti, R. (Universita degli Studi della Calabria, Cosenza, Italy); Giovanelli, R. Basile, A.B. 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

An analytic-statistic approach is presented of the fluid-dynamic model of the turbulence near the walls, when induced or inherent vibrations are present. This model is founded on a mixed Eulerian-Lagrangian treatment of the probability density function for the vorticity distribution. From the evaluation of the principal research works concerning the vibrational problem some reliable indications are derived to support the proposed model of turbulence.

34779 **(NUREG/CP—0014(Vol.2)) Proceedings of the ANS/ASME/NRC international topical meeting on nuclear reactor thermal-hydraulics: fundamental aspects of two-phase flow and boiling heat transfer.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Aug 1980. 790p. (CONF-801002—(Vol.2)). NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Separate abstracts are included for each of the papers presented concerning critical flow of two-phase mixtures; two-phase flow instrumentation; critical heat flux and effects of local disturbances; heat transfer and rewetting during reflood; hydrodynamic mechanisms in boiling heat transfer; and entrainment and droplet deposition in two-phase flow. Five papers have been previously abstracted and input to the data base.

34780 (NUREG/CP—0014(Vol.2), pp 1384-1417) **Experimental study of steam condensation inside horizontal tubes.** Vocino, V. (CISE, Milano, Italy); Cabella, A. Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A common requirement, arising both from the experience during MSR (Moisture Separator Reheater) operation and from the theoretical-experimental studies performed to support its development, is that of deeper understanding of the problems connected with the behaviour of condensing steam inside horizontal tubes. With this purpose, small and large scale experiments have been planned. At present, small scale experiments have been completed in view of studying pressure drops and heat transfer coefficients of condensing steam inside a 1m horizontal tube of the same type as used in MSRs. In particular, the influence of different circumferential heat flux distributions on condensing steam heat transfer has been investigated. The distributions have been obtained by varying both the cooling air flow direction and the air duct geometry.

## 2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

*REFER ALSO TO CITATION(S) 34778, 34779, 34780, 34848, 34849, 34850, 34853, 34854, 34855, 34856, 34864, 34865, 34866, 34867, 34870, 34871, 34872, 34873, 34874, 34875, 34876, 34877, 34878, 34879, 34881, 34882, 34883, 34884, 34885, 34886, 34887, 34888, 34889, 34890, 34891, 34892, 34893, 34894, 34895, 34896, 34897, 34898, 34900*

34781 (NUREG/CP—0014(Vol.1), pp 482-503) **Parametric computations for the thermal-hydraulic performance of a PWR steam generator.** Singhal, A.K.; Marchand, E.O.; Spalding, D.B. (CHAM of North America Inc., Huntsville, AL). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A series of three-dimensional, two-phase flow and heat-transfer calculations has been performed for a recirculating-type steam

generator, by varying selected constants in the empirical correlations for heat-transfer and frictional resistances. Solution sensitivities are analyzed by examining the distributions of the pressure, velocity and void fraction of the secondary fluid, and of the temperature of the primary fluid (pressurized water flowing inside the U-tubes). Calculated global quantities such as the circulation ratio and the primary-fluid-temperature level are also studied. The computations have been performed by using the URSULA2 computer program in it homogeneous-flow-model option. No comparisons with experiment are made, because no data are yet available.

**34782** (NUREG/CP—0014(Vol.1), pp 733-752) **Flow induced vibrations of a PWR upper guide structure tube bank model.** Guerrero, H.N.; Haslinger, K.H.; Lubin, B.T.; Rossano, F.V. (C-E Power Systems, Windsor, CT). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Flow vibration tests were conducted on a PWR upper guide structure (UGS) tube bank model wherein ther flow pattern consisted of combined axial and cross flows. The Reynolds number of the tests spanned the transcritical to supercritical range ($5 \times 10^5$ to $5 \times 10^6$). The tube excitation mechanisms consisted of turbulent buffetting observed at low flows and fluidelastic excitation observed at flows beyond the design conditions. Incremental increases in flow beyond the onset velocity caused the tubes responses to be reduced in amplitude and become random. Further flow increases led to increased vibration amplitudes and once more, periodic response. The observed natural frequencies, modal damping valves and critical velocities were compared with predictions from Chen's Theory on dynamic behavior of tube banks and other available analytical methods.

## 2103 Power Reactors, Non-breeding, Graphite Moderated

*REFER ALSO TO CITATION(S) 34353, 34796, 34909, 34911*

**34783** (NUREG/CP—0014(Vol.2), pp 955-969) **Voidage in a serpentine geometry nuclear boiler tube.** Pye, J.W.; Chojnowski, B. (Marchwood Engineering Labs., Southampton, England). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Dynamic stability threshold predictions for the once-through AGR boilers were found to be sensitive to voidage input values. Since reliable data were lacking, measurements of voidage were undertaken on a full-size serpentine boiler tube operating under representative plant conditions by use of gamma-densitometry. These measurements involved multi-chordal scanning with subsequent integration over the tube cross-section to minimize errors in mean fluid density determination. Slip ratios were computed assuming equilibrium between phases.

**34784** (NUREG/CP—0014(Vol.3), pp 2147-2175) **Review of gas cooled reactors thermal hydraulics.** Melese d'Hospital, G.B. (General Atomic Co., San Diego, CA). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Gas cooled reactor characteristics have greatly improved from the early Magnox reactors, to AGR and HTGR, with higher coolant temperatures and pressures leading to about 40% net cycle efficiency. Carbon dioxide and helium give comparable thermal performance and, when pressurized to about 10 MPa, allow heat fluxes comparable to those obtained with sodium in fast breeder reactors. Although experimental results and analyses have led to a great wealth of correlations and codes for helium cooled reactors, HTGR, Pebble beds and GCFR, better understanding of some specific thermal hydraulics problems such as natural convection would still be useful to the reactor designer.

**34785** (NUREG/CP—0014(Vol.3), pp 2189-2203) **Disturbance of the cooling-gas distribution in HTGR fuel blocks due to bypass flow.** Groehn, H.G. (Kernforschungsanlage, Juelich, Germany). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The influence of bypass flow on the main flow distribution through the coolant channels of a HTGR fuel element has been investigated. The bypass flow was introduced through a wedge shaped gap located between two succeeding blocks. The gap width varied in the range of 1.85 to 6 mm. The velocity distribution over the cross section and the pressure loss over the gap have been measured. The maximum ratio bypass flow to main flow was o.2. The experimental results allow the prediction of the flow reduction in each coolant channel depending on the transverse pressure gradient driving the bypass flow.

**34786** (NUREG/CP—0014(Vol.3), pp 2296-2314) **Asymmetric velocity distribution in a plane channel with artificial roughness.** Meyer, L. (Kernforschungszentrum, Karlsruhe, Germany). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

From velocity measurements in a rectangular channel with one artificially roughened wall, the parameters of the non-dimensional velocity profiles are determined. The slope of the law of the wall was found to vary with roughness geometry and relative roughness height. An assessment of the transformation method, which uses these parameters to calculate the flow in asymmetric channels and rod bundles is given.

**34787** (NUREG/CP—0014(Vol.3), pp 2337-2351) **Behavior of thermal insulations for hot gas ducts of high temperature gas cooled reactors.** Broeckerhoff, P. (Kernforschungsanlage, Juelich, Germany). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Four types of insulations have been tested mainly in a high pressure wind tunnel at a pressure up to 40 bars and a temperature up to 400°C. Both air and helium have been used as coolant. The test body was mounted horizontally. The cooling system welded to the outside of the pressure tube was subdivided into four sectors over the circumference. Thus, it was possible to study the influence of free convection at different operating conditions. Some tests in stagnant gas have been carried out in vertical position of the test tube. In this case electrical heating has been applied. The highest temperature achieved was 760°C at nearly 40 bars. Radial and axial temperature distributions, thermal fluxes, and effective thermal conductivities have been measured.

**34788** (NUREG/CP—0014(Vol.3), pp 2370-2389) **Steady-state thermal-hydraulic model for gas-cooled pebble bed reactor cores.** Stroh, K.R. (Los Alamos Scientific Lab., NM); Olson, H.G.; Jiacoletti, R.J. 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A model for the analysis of coupled thermal-hydraulic problems in steady-state pebble bed nuclear reactor cores is presented. The bed has been treated macroscopically as a generating, conducting porous medium. None of the usual simplifying assumptions such as constant properties, constant velocity flow, or negligible conduction and/or radiation are used. A computer program based on this model has been constructed; it has been partially validated by comparing flow predictions with measured experimental values. The program has been applied to the analysis of a large power reactor design.

**34789** (NUREG/CP—0014(Vol.3), pp 2390-2403) **Forced convective heat transfer and pressure drop of a randomly packed HTGR core.** Achenbach, E. (Kernforschungsanlage, Juelich, Germany). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Heat and mass transfer have been measured for a randomly packed spherical pebble bed in the range of Reynolds number $30 < Re < 5 \times 10^4$. The Prandtl number was $Pr = 0.71$. For the mass transfer measurements the method of naphthalene sublimation in air (Schmidt number $Sc = 2.53$) was applied. Effects of free convection, of temperature radiation, and of heat flux due to punctual contact of neighboring spheres are studied. Furthermore the wall effects on heat transfer are considered. For $3 \times 10^2 < Re < 4 \times 10^4$ the pressure drop coefficient has been measured. The importance of exact knowledge about the void fraction and its effect on the pressure drop is pointed out.

34790 (NUREG/CP—0014(Vol.3), pp 2404-2425) **Thermal-hydraulics of pebble-bed reactors.** Gysler, G.; Haque, H. (Internationale Atomreaktorbau, Bergisch Gladbach, Germany). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

This paper deals with the application of the subchannel code COBRA-III-C to the thermal-hydraulic analysis of pebble-bed reactor cores. The validity of basic assumptions of the COBRA-III- C-model for a pebble-bed reactor core is discussed and specific modifications for this type of core are described. The use of the modified program for the thermal-hydraulic design of such a core is demonstrated for several problems, i.e. the calculation of flow and temperature fields during normal operation, operation with a stuck rod and post shutdown heat removal. It is concluded that the modified code version can be applied successfully to such analyses.

34791 **(ORNL/TM—7853) Deposition and characterization of pyrocarbon coatings produced by use of $CO_2$ dilution.** Stinton, D.P.; Lackey, W.J. (Oak Ridge National Lab., TN (USA)). Oct 1981. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01. Order Number DE82000900.

A Biso-coated fuel particle for the High-Temperature Gas-Cooled Reactor (HTGR) consists of a 500 $\mu$m $ThO_2$ kernel, an 85-$\mu$m layer of low-density carbon, and a 75-$\mu$m layer of high-density pyrocarbon. Coatings produced from mixtures of 50% propylene, 25% $CO_2$, and 25% Ar were found to be more gastight than were coatings produced from mixtures of propylene and argon, helium, or $H_2$. Higher concentrations of $CO_2$ in the gas mixture caused severe oxidation of graphite components within the coating furnace. The permeability of coatings deposited by use of $CO_2$ dilution was found to depend on the deposition temperature. Low deposition temperatures produced more gastight coatings. It was determined that $CO_2$ had little or no effect on coating anisotropy. 6 figures.

## 2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

*REFER ALSO TO CITATION(S) 34868, 34915*

34792 (NUREG/CP—0014(Vol.1), pp 221-240) **Analysis of coolant flow distribution in FUGEN reactor core.** Sugawara, S.; Kobori, T. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki, Japan). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

This paper describes the prediction and measurement of channel flow distribution in HWR prototype reactor FUGEN. For prediction, a number of hydraulic test have been carried out to obtain pressure drop correlations in single-phase and steam/water two-phase flow for rod bundles, spacers, inlet and outlet pipes, and bends. Channel flow was actually measured in FUGEN reactor on all 224 channels at room temperature and on 18 channels in particular at various power operating conditions. The predictions agree with the measured data of channel flow rate within 1 percent for non-boiling conditions, and an approximately 3 percent standard deviation under boiling conditions.

## 2105 Power Reactors, Breeding

*REFER ALSO TO CITATION(S) 34355, 34846, 34847, 34852, 34901, 34902, 34903, 34904, 34905, 34906, 34908, 34910, 34916, 34917*

34793 **(DOE/SF/71031—T25) FFTF MOTA: design thermal and stress overcheck analyses.** Yung, F.; Marshall, J. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Jun 1978. Contract AT03-76SF71031. 3p. NTIS, PC A02/MF A01. Order Number DE81027367.

This report describes a preliminary study of temperature distribution and stress level for the FTR material open test assembly (MOTA) specimen cannister. Upper bound thermal results are produced with the binary gas mixture Helium/Argon ratio equal to 0.0001 coupled with 2.0 watts/gram and 6.0 watts/gram gamma heating for the stainless steel structure and specimens.

34794 **(ENICO—1091) Revised EBR-II fast-reactor fission yields for $^{233}U$, $^{235}U$, and $^{238}U$.** Maeck, W.J.; Tromp, R.L. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Aug 1981. Contract AC07-79ID01675. 75p. NTIS, PC A04/MF A01. Order Number DE82000407.

Revised and updated fast reactor fission yield values are reported for over 40 stable and long-lived nuclides for the fission of $^{233}U$, $^{235}U$, and $^{238}U$ in Row 8 of the Experimental Breeder Reactor-II. Based on the reanalysis of these samples for fission product lanthanum and cerium using improved mass spectrometric analysis procedures, significant changes in the yields, up to 10%, for the fission product nuclides of these elements are indicated. Details relative to the measurements and calculation of the yields are given. These data supersede earlier values published by this laboratory in 1975.

34795 **(EPRI-NP—1972) Achievements, findings, and lessons of the Phenix LMFBR power plant experience: executive summary. Final report.** Wolfe, W.B. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Aug 1981. 49p. NTIS, PC A03/MF A01. Order Number DE81904227.

The French 250-MW(e) Phenix Liquid Metal Fast Breeder Reactor (LMFBR) has become distinguished by its noteworthy record of construction, operation, and maintenance. This report summarizes the published Phenix information, emphasizing those aspects of the Phenix experience which are of particular interest in the consideration of LMFBRs for large central station power generation. The report provides a summary of the Phenix construction, startup, operation, and maintenance activities. Detailed information supporting this summary is contained in EPRI report NP-1973.

34796 **(NUREG/CP—0014(Vol.3)) Proceedings of the ANS/ASME/NRC international topical meeting on nuclear reactor thermal-hydraulics: LMFBR and HTGR advanced reactor concepts and analysis methods.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). 1980. 855p. (CONF-801002—(Vol.3)). NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Separate abstracts are included for each of the papers presented concerning the thermal-hydraulics of LMFBR type reactors; mathematical methods in nuclear reactor thermal-hydraulics; heat transfer in gas-cooled reactors; and thermal-hydraulics of pebble-bed reactors. Two papers have been previously abstracted and input to the data base.

34797 (NUREG/CP—0014(Vol.3), pp 1597-1612) **Thermohydraulic studies with seven-rod bundle tests for the evaluation of non-nominal geometry effects on LMFBR fuel elements.** Falzetti, L.; Iannuzzo, P.; Pezzilli, M. (CNEN, Rome, Italy). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The paper describes a recent, more realistic approach to the knowledge of thermohydraulic behavior of FBR fuel elements during operation under conditions of geometrical anomalies arising

from thermal and irradiation effects. Out-of-pile in-sodium tests were performed in simple bundle geometry (seven pins electrically heated and wire-wrap spaced) including non-nominal geometry by simulating swelling deformation in one peripheral pin. Temperature maps, obtained in differently instrumented sections of the bundle under a wide range of operating conditions, were compared with a sophisticated heat conduction code to evaluate local effects and utilized to validate computation codes for subassembly design. In this paper a rapid review of experimental results and theoretical works is presented, together with a short description of the developed test-section technology.

34798 (NUREG/CP—0014(Vol.3), pp 1644-1662) **Effect of heat input patterns on temperature distribution in LMFBR blanket assemblies.** Engel, F.C.; Markley, R.A.; Minushkin, B. (Westinghouse Electric Corp., Madison, PA). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Heat transfer tests were conducted over a wide range of sodium flow rates and heat input using a full scale, vertical, electrical-resistance heated rod bundle simulating conditions in a breeder reactor blanket assembly. The rod bundle was extensively instrumented with thermocouples located at six different elevations in the wire wrap spacers and inside the cladding to map temperature distributions in the rod bundle. The rod heat input had a 1.4:1 maximum-to-average axial cosine shape. Rod heat input powers simulating a number of power distributions in LMFBR Radial and Inner Blanket Assemblies were established. The resulting transverse temperature profiles across the rod bundle are presented for three elevations for tests of about 440 kW heat input and gpm flow. The temperature distribution was found to follow the heat input profile but is modified by mixing and the flow distribution over side and inside flow subchannels. These profiles were compared with predictions of a subchannel computer code of the marching type.

34799 (NUREG/CP—0014(Vol.3), pp 1663-1679) **Special aspects of the thermohydraulic design analysis of fuel subassemblies for LMFBR's.** Weber, G. (Internationale Atomreaktorbau GmbH, Bergisch Gladbach, Germany); Cornet, G. 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Thermohydraulic calculations have been performed for bundles with spacer grids applying the subchannel analysis method. The influence of geometric changes due to tolerances and clearances and due to irradiation effects on thermohydraulics results have been studied. Special attention has been paid to the influence of the spacer grid dimensions and to the influence of the irradiation-creep deformation of the wrapper tube.

34800 (NUREG/CP—0014(Vol.3), pp 1680-1697) **Computer code FLOWER which analyzes turbulent thermal-hydraulic and fuel-pin-bowing characteristics of a wire wrapped LMFBR fuel assembly.** Itoh, K.; Seino, S.; Ishii, T.; Kubota, T. (Mitsubishi Atomic Power Industries Inc., Saitama, Japan). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A computer code FLOWER has been developed to analyze turbulent coolant flow and temperature distributions in an LMFBR wire wrapped fuel assembly. In the code, a fuel bundle bowing analysis was combined with a thermal hydraulic analysis so as to calculate thermal hydraulic characteristics after the occurrence of bowing may happen under the operating condition. Sample calculation results indicate that coolant axial velocities are nearly uniform across a fuel bundle, and that fuel pins contact through spacer wires when the bundle bowing occurs, while slight ansymmetry of the temperature distribution is generated by the bowing.

34801 (NUREG/CP—0014(Vol.3), pp 1732-1746) **Physical modeling of thermohydraulic phenomena in LMFBR.** Vidil, R.; Martin, R.; Grand, D. (Centre d'Etudes Nucleaires de Grenoble, France). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A simulation method of thermohydraulic problems in LMFBR is illustrated by a dimensional analysis of the different equations. For steady state and transient regimes on the reactor, it is shown how some experiments on small scale models with usual fluid permit a tentative solution to these problems.

34802 (NUREG/CP—0014(Vol.3), pp 1747-1765) **Thermo- and fluiddynamics of LMFBR fuel subassemblies under nominal and non-nominal operating conditions (status).** Hoffmann, H.; Hofmann, F.; Rehme, K. (Kernforschungszentrum, Karlsruhe, Germany). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The present status of theoretical and experimental research work at KfK presented in this paper, can be subdivided into the following main topics: physical and mathematical modelling of single phase rod bundle thermo- and fluiddynamics; and experimental investigations on heat transfer and fluid flow in rod bundles. Up till now, most of the thermo- and fluiddynamic activities, both theoretical and experimental activities, performed under the Fast Breeder Program at KfK are related mainly to undisturbed normal operation. In the future emphasis will be put on non-nominal geometry and quasi-steady state conditions. Up to now heat transfer experiments with bowed rods have been performed.

34803 (NUREG/CP—0014(Vol.3), pp 1766-1788) **Subchannel and bundle friction factors and flow split parameters for laminar transition and turbulent longitudinal flows in wire wrap spaced hexagonal arrays.** Hawley, J.T. (Massachusetts Inst. of Tech., Cambridge); Chiu, C.; Todreas, N.E.; Rohsenow, W.M. 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Correlations are presented for subchannel and bundle friction factors and flowsplit parameters for laminar, transition and turbulent longitudinal flows in wire wrap spaced hexagonal arrays. These results are obtained from pressure drop models of flow in individual subchannels. For turbulent flow, an existing pressure drop model for flow in edge subchannels is extended, and the resulting edge subchannel friction factor is identified. Using the expressions for flowsplit parameters and the equal pressure drops assumption, the interior subchannel and bundle friction factors are obtained. For laminar flow, models are developed for pressure drops of individual subchannels. From these models, expressions for the subchannel friction factors are identified and expressions for the flowsplit parameters are derived.

34804 (NUREG/CP—0014(Vol.3), pp 1789-1804) **Investigations of turbulent velocity and mass flow distribution in rod bundles with grid-type spacers.** Trippe, G.; Weinberg, D. (Kernforschungszentrum, Karlsruhe, Germany). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Thermo- and fluid dynamic design calculations of LMFBR subassemblies are performed by subchannel analysis. The results computed by subchannel codes essentially depend on the empirical code inputs. The experimentally confirmed knowledge of the three-dimensional flow events in rod bundles provided without and with spacer grids is therefore very important. This paper presents very detailed local axial velocity measurements carried out in turbulently flowing water within a 19-rod bundle test section with hexagonally arranged rods (P/D = 1.30, W/D = 1.17) without and with grid type spacers. These experimental data were used to check and verify local and subchannel codes.

34805 (NUREG/CP—0014(Vol.3), pp 1805-1817) **Computer code development for three-dimensional thermo-hydraulic analyses of coolant behavior in an LMFBR plenum.** Hirata, N. (Toshiba Corp., Kawasaki, Japan); Arai, M.; Mawatari, K.; Yoneda, T.; Takenouchi, S. 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A computer code (THAUPR) has been developed to predict the transient velocity and temperature fields in plenums of a

Liquid-Metal Cooled Fast Breeder Reactor (LMFBR). The time averaged conservation equations for mass, momentum and energy were solved with cylindrical three-dimensional coordinates. Steady state and various transient operational conditions were easily calculated. Flow and temperature field predictions are presented. The predictions are in qualitative agreement with expectations.

34806 (NUREG/CP—0014(Vol.3), pp 1818-1835) **Thermal diffusivity measurements of recirculating flows to validate model tests for liquid metal reactors.** Freeman, A.R.; Smith, R.M. (Central Electricity Generating Board, Berkeley, England). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Before data from water model tests can be applied to sodium-cooled reactors, a lower limit for Reynolds number to give thermal similarity must be established. A route for determining this is to infer the turbulent diffusivity of heat for water and sodium in the relevant geometry by comparing measured temperature profiles to those predicted by a numerical code. Such a code has been developed, based on the finite element method, and its predictions of velocity and temperature fields compared with measurements made in a simple axisymmetric pipe expansion. Initial results are encouraging, but show the need for further refinement of the turbulence model.

34807 (NUREG/CP—0014(Vol.3), pp 1852-1870) **Characterization of the temperature fluctuations generated in a thermal mixing tee (sodium versus water behavior).** Kasza, K.E.; Colwell, W.S. (Argonne National Lab., IL). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The temperature fluctuations occurring in 180° inlet-let angle pipe tee thermal mixers with and without inlet reducer pipes are characterized in both amplitude and frequency. Sodium and water data from different sized tees have allowed delineation of the size and fluid medium modeling laws required for the extrapolation of reduced-scale water model temperature fluctuation data to prototype LMFBR sodium mixers. The phenomena of flow corner cutoff and thermal buoyancy at a tee juncture have also been studied and their effects on mixer performance delineated. The information presented is vital both to the design of thermal-fatigue-free mixers and to the understanding of thermal mixing in complex flows; much of it has not been peviously available.

34808 (NUREG/CP—0014(Vol.3), pp 1871-1881) **Local temperature distributions in the critical duct wall zones of LMFBR core elements. Status of knowledge, unsettled problems and possible solutions.** Moeller, R.; Tschoeke, H. (Kernforschungszentrum, Karlsruhe, Germany). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Of a multitude of local, three-dimensional wall temperature measurements performed in a 19-rod bundle with sodium flow two characteristic experiments will be described which relate to the corner rod (critical bundle zone in terms of thermodynamics). Even relatively little deviations from the ideal geometry results in unexpected asymmetries of the azimuthal wall temperature profiles. Recalculations based on the global ARTIS subchannel code and the real geometry have validated qualitatively the experimental results. Nevertheless, the maximum azimuthal temperature difference is still higher by the factor 2 than the calculated value. Unsettled problems will be described and possible solutions will be outlined.

34809 (NUREG/CP—0014(Vol.3), pp 1882-1895) **Stratification of entrapped sodium as insulation in an LMFBR pool-type reactor vessel.** Martin, C.B. (Combustion Engineering, Inc., Windsor, CT). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The use of thermal stratification of a trapped layer of sodium is demonstrated as an effective method of insulating the thermal-hydraulic separator between the hot and cold pools in a pool-type reactor vessel for a liquid metal fast breeder reactor (LMFBR). Using the VARR-II computer program, a 2-D thermal-hydraulic analysis of the critical cross section of the fluid layer predicts a smoothly changing thermal stratification resulting in the separator exeriencing 11% of the temperature difference between the pools. Vertical nonadiabatic penetrations of the soidum layer create localized natural convection currents which are not found to significantly disrupt the thermal stratification. Several geometric and thermal boundary condition variations are also inspected.

34810 (NUREG/CP—0014(Vol.3), pp 1896-1913) **Predicting the performance of narrow cavity thermal barriers for application in LMFBR's.** Mitchell, C.H. (Nuclear Power Co., Risley, England); Cowan, G.; Sheriff, N. 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A passive thermal barrier which stagnates sodium, is proposed for a liquid metal fast breeder reactor (LMFBR). To validate the design, a program of work is outlined. This program involves the development of computer programs and experimental simulations addressed at natural convection heat transfer in closed and permeable cavity systems.

34811 (NUREG/CP—0014(Vol.3), pp 1914-1925) **Combined convection of sodium in a rectangular cavity.** Grand, D.; Abadie, P.; Martin, R.; Vidil, R. (Centre d'Etudes Nucleaires de Grenoble, France). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A two dimensional flow is induced in a cavity by forced flow in a channel adjacent to it. Buoyancy forces can act upon the flow since a downwards heat flux takes place between one side of the cavity and the channel flow. Results presented include temperature distributions and the overall heat transfer. The partition of the cavity into a stably stratified region and an isothermal recirculation is described with an analytical model.

34812 (NUREG/CP—0014(Vol.3), pp 2126-2146) **Theoretical investigations on thermal-hydraulics of fast reactor fuel rod bundles.** Slagter, W.; Roodbergen, H.A.; Dekker, N.H. (Netherlands Energy Research Foundation, Petten). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Velocity and temperature predictions have been made in a bundle of bare rods with liquid metal cooling by means of the finite element method. A variational principle is applied to develop the finite element relationships. The resulting set of nonlinear algebraic equations for the nodal velocities are solved iteratively using the Newton-Raphson method. The mixing length model of turbulence is applied to predict local velocities and temperatures right up to the wall including anisotropic effects of eddy diffusivities. The numerical results deal with the heat transfer both from the fuel rod surface into subchannels and between subchannels itself, formed by bare rods and arranged in triangular array. A comparison between predictions and measurements in a 19-rod bundle is presented and the agreement is fair.

34813 (NUREG/CP—0014(Vol.3), pp 2204-2221) **CLUHET: a computer code for steady state and single phase thermohydraulic analysis of rod bundles.** Barroyer, P. (Swiss Federal Inst. for Reactor Research, Wuerenlingen). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A steady state thermohydraulic analysis of nuclear reactor fuel rod bundles under single phase flow conditions (pressure, mass flow, fluid and rod temperature distributions) is described with the assumptions used in the CLUHET code. The code structure and the calculations procedure are briefly outlined. An extensive program of comparison with experimental results is in progress. Its principles are indicated and a few preliminary achievements are presented.

34814 (NUREG/CP—0014(Vol.3), pp 2253-2277) **Forced convection heat transfer in a bundle of 12 rods.** Cevolani, S.; Rehme, K. (Kernforschungszentrum, Karlsruhe, Germany). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The paper describes the heat transfer experiments performed with two bundles of 12 electrically heated rough rods. The fundamentals of the SAGAPO code are given. SAGAPO calculates the friction and heat transfer coefficients in turbulent flow by integrating the logarithmic universal laws of the wall for velocity and temperature in the various coolant channels confined by rough surfaces. The code accounts for turbulent mixing and cross flow among the channels, for spacer effects on wall temperatures and pressure drop, for fin efficiency effects due to the roughness ribs, and for inlet effects on wall temperatures in case of smooth rods. Also laminar flow can be calculated. Comparisons between computed and experimental results on pressure and temperature distributions are presented.

34815 (NUREG/CP—0014(Vol.3), pp 2278-2295) **Hexagonal bundle heat transfer and fluid flow experiment AGATHE HEX.** Hudina, M.; Markoczy, G. (Swiss Federal Inst. for Reactor Research, Wuerenlingen). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

An extensive experimental program is being carried out, in order to develop analytical models and comprehensive computer codes for the prediction of temperature and pressure distributions in different fuel element configurations of gas-cooled fast breeder reactors. To prove the quality of the analytical predictions of these codes under different operational conditions, experiments are carried out in hexagonal rod bundle geometries. Short description of the experimental equipment, program and status of measurements together with the main characteristics of the codes are given. The pressure and temperature distributions measured in the first two bundles are compared with the results calculated by codes.

34816 (NUREG/CP—0014(Vol.3), pp 2315-2336) **Turbulent flow structure in a square lattice rod array with smooth and roughened surfaces.** Peng, C.S.P. (Univ. of Texas, Austin); Eaton, T.E.; Neti, S. 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A comparison of turbulent flow phenomenon in smooth and roughened surface square lattice rod bundles is presented. The laser doppler velocimeter data reported here includes mean velocities and turbulence intensities in the axial and normal directions at three Reynolds numbers (10,000, 20,000 and 40,000). Pressure drop data in the smooth and rough bundles are also compared. The results demonstrate the various differences in the flow structure. Increases in the secondary velocity component and turbulence intensity are seen to play a major role in improving the thermal-hydraulic performance of the roughened bundles. The roughened bundle friction factor is almost the same as that of the smooth bundle at very low Reynolds numbers but increases with Reynolds number up to 27,000 and attains a constant value of 0.067.

34817 **(ORNL/CSD—78) Depth-charge static and time-dependence perturbation/sensitivity system for nuclear reactor core analysis.** White, J.R. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 198p. NTIS, PC A09/MF A01. Order Number DE82000509.

This report provides the background theory, user input, and sample problems required for the efficient application of the DEPTH-CHARGE system - a code block for both static and time-dependence perturbation theory and data sensitivity analyses. The DEPTH-CHARGE system is of modular construction and has been implemented within the VENTURE-BURNER computational system at Oak Ridge National Labortary. The DEPTH-CHARGE system provides, for the first time, a complete generalized first-order perturbation/sensitivity theory capability for both static and time-dependent analysis of realistic multidimensional reactor models.

34818 **(ORNL/TM—7891) Pressure drop and heat transfer correlations for use in CFTL bundle analysis.** Hodge, S.A.; Meyer, L. (Oak Ridge National Lab., TN (USA)). Oct 1981. Contract W-7405-ENG-26. 43p. NTIS, PC A03/MF A01. Order Number DE82000530.

The friction factor and Stanton number for flow past a roughened surface are determined by the parameters A and R($h^+$) of the universal law of friction and the parameters A/sub H/ and G($h^+$) of the universal law of heat transfer. The methods used for experimental determination of these parameters for the particular roughness and rod diameter proposed for use in the Core Flow Test Loop (CFTL) are presented and recommended values for use in CFTL bundle flow analysis are prescribed.

34819 **(PNL—3596) Characterization of alternative FBR development strategies.** Boegel, A.J.; Clausen, M.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1981. Contract AC06-RL01830. 126p. NTIS, PC A07/MF A01. Order Number DE82000417.

Near-term decisions regarding the nature and place of the FBR development program must be made. This study is part of a larger program designed to provide the Department of Energy (DOE) with imformation that can be used to make strategic programmatic decisions. The focus of this report is the description of alternative approaches for developing the FBR and the quantification of the duration and cost of each alternative. The time frames of the alternative approaches are investigated in companion reports (White 1981 and Fraley 1981). The results of these analyses will be described in a summary report (Burnham et al. 1981).

34820 **Operating experience with the EBR-II cover-gas-cleanup system.** Richardson, W.J.; Clark, A.F. (ANL). pp 14-46 of Liquid metal technology in energy production. Chicago, IL; American Nuclear Society (1980).

From 2. international symposium on liquid metal technology in energy production; Richland, WA, USA (20 Apr 1980).

Operation of the EBR-II reactor unit with breached fuel elements in the reactor core introduces radioactive fission gases into the argon cover gas. To alleviate problems created, a cover-gas-cleanup system was installed. The system removes krypton, xenon, and other condensable gases, using a cryogenic distillation process. A continuous and automatic xenon-tag trapping and analysis system is included. The combination of the two systems allows for the breached element identification. (3 diagrams, 1 graph, 1 reference)

34821 **Evaluation of incoherency effect on cladding motion in LMFBR loss-of-flow accident experiments based on a multichannel model.** Kuzay, T.M.; Chen, W.L.; Ishii, M. (Argonne Natl Lab, Ill). pp 1519-1547 of Multiphase transport: fundamentals, reactor safety, applications (proceedings of the multi-phase flow and heat transfer symposium-workshop), 1979. Veziroglu, T.N. (ed.). Washington, DC; Hemisphere Publishing Corp. (1979).

From 2. multiphase flow and heat transfer symposium workshop; Miami Beach, FL, USA (16 Apr 1979).

In a hypothetical unprotected loss-of-flow accident in liquid-metal fast breeder reactors, coolant sodium is rapidly heated to boiling. The sodium boiling leads to dryout and virtual loss of cooling from cladding surfaces. The three experiments considered to study incoherency effects in a rod bundle are R4 and R5 series tests of TREAT in-pile experiments and the recently completed P3A test by SLSF (Sodium Loop Safety Facility) Project in the Engineering Test Reactor. A computer code MULCLAD which is based on multichannel cladding motion model is used for the comparative studies with the experimental data. 12 refs.

34822 **(DOE/SF/01435—T6) Engineering design study.** (General Electric Co., Sunnyvale, CA (USA)). [nd]. Contract AC03-77SF01435. 8p. NTIS, PC A02/MF A01. Order Number DE81025940.

Differences between GCFR and LMFBR assemblies are listed and the implications for the staggered-grid spacer discussed. It is concluded that the GE staggered-grid spacer appears to be a feasible option for the GCFR. Assumptions and constraints for the GCFR fuel fabrication cost study are listed. (DLC)

### 2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

*REFER ALSO TO CITATION(S) 34914*

### 2107 Regulation And Licensing

*REFER ALSO TO CITATION(S) 34913*

**34823 (NE-E—8-18T) Threaded fasteners for nuclear components.** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Sep 1981. 11p. Nuclear Standards Management Center, Oak Ridge, TN. Order Number DE81030462.

This standard covers threaded fasteners for use in nuclear and associated applications to be manufactured from specified bolting material furnished as forgings, rod, or bar stock.

**34824 (NE-M—6-4T) Alloy steel nuts for bolting for high-pressure and high-temperature service (ASME SA-194 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Sep 1981. 9p. Nuclear Standards Management Center, Oak Ridge, TN. Order Number DE81030924.

This standard covers alloy steel nuts for bolting for high-pressure and high-temperature service in nuclear and associated applications. This standard does not cover bar or other starting materials. The only implied special considerations for starting materials are that they be capable of passing the required tests when processed into finished products in accordance with this standard.

**34825 (NE-M—4-6T-9-81-Rev.) Steel castings for nuclear and other special applications (ASME SA-613 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Sep 1981. 9p. Nuclear Standards Management Center, Oak Ridge, TN. Order Number DE81030869.

This standard covers carbon steel and medium- and high-alloy steel castings for nuclear and associated applications.

**34826 (NE-M—7-4T-9-81-Rev.) Nickel-chromium-iron alloy rod and bar (ASME SB-166 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Sep 1981. 8p. Nuclear Standards Management Center, Oak Ridge, TN. Order Number DE81030927.

This standard covers nickel-chromium-iron alloy rod and bar for nuclear and associated applications.

**34827 (NE-M—7-10T-9-81-Rev.) Nickel-iron-chromium alloy rod and bar (ASME SB-408 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Sep 1981. 8p. Nuclear Standards Management Center, Oak Ridge, TN. Order Number DE81030922.

This standard covers nickel-iron-chromium alloy rod and bar forgings for nuclear and associated applications.

**34828 (NE-M—7-6T-9-81-Rev.) Precipitation-hardening stainless steel bars, shapes, and forgings (ASME SA-564 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Sep 1981. 11p. Nuclear Standards Management Center, Oak Ridge, TN. Order Number DE81030926.

This standard covers precipitation-hardening stainless steel bars, shapes, and forgings for nuclear and associated applications.

**34829 (NE-M—5-7T-9-81-Rev.) Nickel-iron-chromium alloy plate, sheet, and strip (ASME SB-409 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Sep 1981. 8p. Nuclear Standards Management Center, Oak Ridge, TN. Order Number DE81030708.

This standard covers nickel-iron-chromium alloy plate, sheet, and strip for nuclear and associated applications. Material shall conform to the requirements of ASME SB-409; to the requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000; and to the additional requirements of this standard.

**34830 (NE-M—6-3T-9-81-Rev.) Alloy steel bolting material for high-temperature service (ASME SA-193 with additional requirements).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Sep 1981. 10p. Nuclear Standards Management Center, Oak Ridge, TN. Order Number DE81030923.

This standard covers alloy steel bolting material (bar, bolts, screws, studs, and stud bolts) for nuclear and associated applications. Material shall conform to the requirements of ASME SA-193; to the requirements of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Article NB-2000; to the requirements of NE E 8-18 for finished products; and to the additional requirements of this standard.

### 2108 Economics

*REFER ALSO TO CITATION(S) 34795*

## 22 NUCLEAR REACTOR TECHNOLOGY

### 2201 Theory And Calculation

**34831 (CISE—1632) An analytical multigroup coarse-mesh method which rigorously determines the core local flux.** Bottoni, G.M.; Bassini, A. (Centro Informazioni Studi Esperienze, Milan (Italy)). 1980. 15p. NTIS (US Sales Only), PC A02/MF A01.

Both the node averaged fluxes and the local fluxes inside the node, usually determined separately in coarse-mesh methods, are obtained on the basis of only one scheme. This approach links together the advantages of an increased logical accuracy with those of a decreased computational complexity. Owing to the arbitrariness in the choice of the trial functions, the method may be easily modified to take into account any suggestion that may arise in the future from practical applications.

**34832 (EPRI-NP—209) Studies of thermal-reactor benchmark-data interpretation: experimental corrections.** Sher, R.; Fiarman, S. (Stanford Univ., CA (USA). Dept. of Mechanical Engineering). Oct 1976. 70p. NTIS, PC A04/MF A01. Order Number DE82900022.

Experimental values of integral parameters of the lattices studied in this report, i.e., the MIT($D_2O$) and TRX benchmark lattices have been re-examined and revised. The revisions correct several systematic errors that have been previously ignored or considered insignificant. These systematic errors are discussed in detail. The final corrected values are presented.

**34833 (ORNL/TM—7589) Development of depletion perturbation theory for a reactor nodal code.** Bowman, S.M. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 165p. NTIS, PC A08/MF A01. Order Number DE81030695.

A generalized depletion perturbation (DPT) theory formulation for light water reactor (LWR) depletion problems is developed and implemented into the three-dimensional LWR nodal code SIMULATE. This development applies the principles of the original derivation by M.L. Williams to the nodal equations solved by SIMULATE. The present formulation is first described in detail, and the nodal coupling methodology in SIMULATE is used to determine partial derivatives of the coupling coefficients. The modifications to the original code and the new DPT options available to the user are discussed. Finally, the accuracy and the applicability of the new DPT capability to LWR design analysis are examined for several LWR depletion test cases. The cases range from simple static cases to a realistic PWR model for an entire fuel cycle. Responses of interest included K/sub eff/, nodal peaking, and peak nodal ex-

posure. The nonlinear behavior of responses with respect to perturbations of the various types of cross sections was also investigated. The time-dependence of the sensitivity coefficients for different responses was examined and compared. Comparison of DPT results for these examples to direct calculations reveals the limited applicability of depletion perturbation theory to LWR design calculations at the present. The reasons for these restrictions are discussed, and several methods which might improve the computational accuracy of DPT are proposed for future research.

**34834 (PNL—3977) Analysis of thorium-salted fuels to improve uranium utilization in the once-through fuel cycle.** Eschbach, E.A.; Merrill, E.T.; Prichard, A.W. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1981. Contract AC06-76RL01830. 41p. NTIS, PC A03/MF A01. Order Number DE82000809.

Calculations and analyses indicate that no improvement can be achieved in uranium utilization for the once-through LWR fuel cycle over use of slightly enriched uranium by employing thorium distributed with uranium. The study included thorium additions: (1) slight amounts, (2) larger amounts, in either intimately mixed or in duplex pellets, (3) in spectrally shifted or not spectrally shifted reactors, and (4) in three- or five-year reactivity limited exposures. While thorium-uranium combinations improves the initial conversion ratio, the reactivity lifetime was not extended enough to override the additional uranium required. The effective fission cross-section of the bred $^{233}U$ relative to $^{239}Pu$'s in typical LWR neutron spectra is not large enough for $^{233}U$ to make as great a contribution to end-of-life reactivity as $^{239}Pu$ in a slightly enriched uranium fuel element. $^{233}U$'s reactivity contribution relative to $^{239}Pu$'s is lower in fuel configurations such as slightly enriched uranium LWR fuel loads. On the other hand, $^{233}U$'s reactivity contribution appears more positive for reactors that involve lower average concentrations of thermal neutron absorbers. If $^{238}U$-thorium fuels reprocessed, the recovered $^{233}U$ would increase uranium utilization, but may not reduce fuel cycle costs. The thorium-salted fuels exhibit substantially flatter reactivity characteristics with exposure time. Spectral shift helped the utilization of uranium and thorium.

**34835 Analysis of neutron yield produced by high-energy protons.** Nakakhara, J.; Takakhashi, Kh. (Brookhaven National Lab., Upton, NY (USA)). *Atomnaya Energiya ;* **47**: No. 2, 83-91(Aug 1979). (In Russian).

The calculation methods for neutron yields produced by high-energy protons in a reactor with a linear accelerator are analyzed. An intense neutron flux, which is used for division of enriched nuclear fuel, is obtained bombarding the Pb-Bi target by the proton or deuteron beam. Compared are the results calculated with the help of the program developed in the Brookhaven National laboratory (BNL) and the experimental results obtained for blocks of natural and enriched uranium of the 56x56x64 cm size and having the lead walls at an initial proton energy of 300-660 MeV. Compared are the neutron yields, distributions of the event density of radiation capture of sup(238)U(n, $\gamma$) and the number of division events. The calculation methods underestimate the total neutron yields depending on the proton energy up to 16.8-29.8 % in comparison with the measurement results. The calculated distribution of the radiation capture events has a higher peak in the central part of the target system and a steeper gradient according to r- and z-directions. It is found that the approximation using 30 energetic neutron groups can be considered satisfactory.

## 2202 Components And Accessories

**34836 (EPRI-NP—1976) Steam generator chemical cleaning: demonstration test No. 2 in a pot boiler.** Key, G.L.; Fink, G.C.; Helyer, M.H. (Combustion Engineering, Inc., Windsor, CT (USA). Nuclear Power Systems). Aug 1981. 91p. NTIS, PC A05/MF A01. Order Number DE81904251.

The effectiveness of the EPRI Mark II chemical cleaning solvent process was tested utilizing a 4-tube pot boiler that had previously been fouled and dented under 81 days of high chloride fault chemistry operation. One laboratory cleaning demonstration of 94.25 hours was performed. Essentially all of the low copper content (approximately 5%) sludge was removed. Approximately 38% of the previously fouled and dented tube/ring and tube/support crevice regions were effectively cleaned. Severe localized corrosion (predominantly pitting) was observed on A533 Grade A and A508 Class 2 carbon steels (nominal pit depths were 30 and 6 mils, respectively). General surface corrosion and/or minor pitting type corrosion was observed for all other materials tested (Types 405/409 stainless steels and AISI 1010 carbon steel), except for Inconel 600 specimens which had no indications of tube surface corrosion.

**34837 (EPRI-WS—79-174-Vol.4, pp 16p, Paper 59) Development of remote controlled automatic pipe welding machines.** Shinohara, Y.; Satoh, A.; Yamazaki, Y. (Ishikawajima-Harima Heavy Industries Co., Ltd., Yokohama, Japan). May 1980. NTIS, PC A13/MF A01. Order Number DE82900055.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Requirements on the quality of weldment for the nuclear piping system are getting more severe than ever experienced. IHI has been concerned with the research and development on the design and manufacturing of highly automated welding machines most adaptable for the fabrication of nuclear components. Already, orbital welding, internal overlay welding, hot wire Gas Tungsten Arc Welding and all position precision Gas Tungsten Arc Welding machines have been designed, manufactured in research institute of IHI and practically used in the work shops and also erection site. These welding machines were furnished with superior characteristics from the fabrication technology point of view for nuclear components, and furthermore, they show excellent usability.

**34838 (NUREG/CP—0014(Vol.2), pp 934-954) Nonintrusive local density determination using gamma scattering or neutron activation.** Kondic, N.N. (Nuclear Regulatory Commission, Washington, DC). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Nonintrusive local density measurements can be made with radiation scattering densitometers having two radiation sources and two detectors. Published applications of scattering either require instrumentation movement or render the density field solution by differentiation or integration of measured functions. This paper describes how both local density values along one line and line-average density values lateral to the line can be determined simultaneously throughout the unknown density field, employing stationary instrumentation and algebraic equations only.

## 2203 Fuel Elements

*REFER ALSO TO CITATION(S) 35334*

**34839 (EPRI-SR—25) Planning support document for the EPRI light-water-reactor fuel-rod-performance program.** Roberts, J.T.A.; Gelhaus, F.E. (Electric Power Research Inst., Palo Alto, CA (USA). Nuclear Power Div.). Dec 1975. 73p. NTIS, PC A04/MF A01. Order Number DE82900104.

The funded projects are listed by title, RP number, and contractor(s). Fuel Rod Studies: Zircaloy-Steam Oxidation Kinetics, EPRI/MPC Zircaloy-LOCA Project, EPRI/NASA Coop. Project on Zircaloy Stress Corrosion Cracking, Zircaloy Inelastic Deformation Study, Plutonia Fuel Study, $UO_2$ Cracking and Relocation Study, Halden Reactor Program Membership, EPRI Test Program in Halden - IFA 435, Studsvik BWR Overpower Ramp Test, and Fuel Rod Code Evaluation. Fuel Bundle Studies: EPRI/CE Coop. Project on PWR Fuel Performance, EPRI/B & W Coop. Project on PWR Fuel Performance, Plutonium Utilization in BWR's, EPRI/EXXON Project on Multiple Plutonium Recycle, and Quad Cities-1 Plutonium Recycle Nuclear and Fuel Performance Measurements. Core Studies: Fuel Performance Evaluation.

**34840 (GEAP—25356) Accelerated pellet-cladding interaction tests of barrier fuel.** Davies, J.H. (Commonwealth Research Corp., Chicago, IL (USA); General Electric Co., San Jose, CA (USA)). Jun 1981. Contract AC02-77ET34001. 64p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE82001140.

An accelerated test for screening potential PCI remedy designs was developed. Fuel rods were designed with a tight diametral fuel-cladding gap and a reduced cladding wall thickness and irradiated in the General Electric Test Reactor. After irradiation at modest powers to about 5 MWd/kg U exposure, the rods were power ramped following a staircase ramp sequence to discriminate rod failure powers. Seven out of seven reference rods (unmodified Zircaloy cladding) failed and six of the seven rods failed in a peak power range around 18.5 kW/ft (54.1 kW/m), benchmarking the performance of the PCI remedy designs. The remedies included: copper, nickel and chromium barriers plated on the cladding inside surface; a pure zirconium liner; buried barriers of niobium and stainless steel; graphite and siloxane coatings. Six of the eight potential PCI remedies also failed, although most outperformed the reference rods. In contrast, seven out of seven copper-barrier rods and two out of two zirconium-liner rods survived, focusing attention on these two designs for further development and implementation. Post-irradiation examination results on both sound and failed rods are discussed.

## 2205 Environmental Aspects

34841 **Application of zone-matching methodology to interacting submerged multiport diffusers.** Eraslan, A.H.; Witten, A.J. (Univ of Tenn, Oak Ridge). *American Society of Mechanical Engineers, [Paper] ;* No. 81-FE-12, 1-10(1981).

A systematic application of a zone-matching methodology is presented for simulating the plant induced flow field from interacting, submerged directional, multiport diffusers, in a coastal region with predominantly natural tidal flow. The diffuser-induced near-field flow is approximately represented as a superposition of radial jets. Each jet near-field flow is determined using a singular perturbation method so as to produce the upstream entrainment characteristic of multiport diffusers. The far-field diffuser-induced flow is determined numerically using a two-dimensional discrete element model. This flow field represents a higher order correction to the near-field flow which satisfies the no-mass flux condition on solid boundaries. Natural flows and other plant induced flows are simulated with the two-dimensional discrete element, hydrodynamic model. 31 refs.

## 2206 Research, Test, And Experimental Reactors

34842 **(DOE/ER/04207—13) Sixteenth progress report of the Texas A and M University Nuclear Science Center, January 1, 1979-December 31, 1979.** Bates, E.F.; Feltz, D.E.; Taft, J.P.; Stasny, G.S.; Walker, K.L. (Texas Engineering Experiment Station, College Station (USA)). Jun 1980. Contract AC05-76ER04207. 80p. (ORO—4207-13). NTIS, PC A05/MF A01. Order Number DE82000421.

The Nuclear Science Center is operated by the Texas Engineering Experiment Station as a service to Texas A and M University and the State of Texas. The facility is available to the University, other educational institutions, governmental agencies, and private organizations and individuals. Reactor utilization continued to grow during 1979 with an increase in the total number of irradiations, sample irradiation hours, number of samples irradiated, and total experiment hours. Reactor operation of 85.71 Mw-days for 1979 was essentially the same as the previous year. The reactor was not pulsed during the reporting period due to a restriction on pulsing until the fuel damage study is completed.

34843 **(ORNL/TM—7910) Oak Ridge Research Reactor quarterly report, July, August, and September of 1980.** Hurt, S.S. III; Lance, E.D. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 30p. NTIS, PC A03/MF A01. Order Number DE81030702.

The ORR operated at an average power level of 29.6 MW for 90.5% of the time during July, August, and September of 1980. The reactor was shut down on twelve occasions, five of which were unscheduled. Reactor downtime needed for refueling, maintenance, and checks was normal, with the reactor remaining available for operation 93.5% of the time. Maintenance activities, both mechanical and instrument, were essentially routine in nature.

## 2209 Reactor Safety

*REFER ALSO TO CITATION(S) 34779, 34948, 35347*

34844 **(CISE—1616) A study on postdryout heat transfer for conditions of interest in loss of coolant accident analysis.** Barzoni, G. (Centro Informazioni Studi Esperienze, Milan (Italy)). 1980. 31p. NTIS (US Sales Only), PC A03/MF A01.

A method to predict heat transfer coefficients in dispersed flow postdryout conditions is discussed. It consists of a theoretical model for actual quality calculation and of a correlation to calculate convection coefficients. Actual quality is expressed as a function of dryout quality, distance from dryout, heat flux, mass flux, tube diameter and fluid properties. To check the method postdryout heat transfer data were obtained at pressures of 30, 50, and 70 bars and mass fluxes of 125, 500, and 1000 kg/sq m/sec, using a special tubular test section. Comparisons among experimental heat transfer coefficients, predictions by the present method, and by some other available methods are reported.

34845 **(CONF-810964—1) Chemistry of fission product iodine in light-water reactors.** Malinauskas, A.P.; Bell, J.T.; Campbell, D.O.; Lorenz, R.A. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01. Order Number DE81030810.

From Seminar on iodine removal from gaseous effluents in the nuclear industry; Mol, Belgium (21 Sep 1981).

Control of fission product iodine in LWRs have been based on the assumption that the bulk of the iodine is uncombined chemically. Recent studies, however, have indicated that fission product iodine released from LWR fuel rods with defected cladding is combined chemically with electropositive species. Thermodynamic studies indicate that the most likely form of the iodine is cesium iodide. In most cases, the chemical form of the radioiodine in the vapor phase is determined by reactions in the aqueous phase. Studies of aqueous iodine chemistry indicate that the predominant dissolved species are iodide and iodate ions in relative concentrations determined by the redox conditions involved. Moreover, volatile species over the aqueous system can be maintained at very low levels. Work performed to date suggests that the dominant chemical form of radioiodine to be controlled in a reactor containment building (excluding aerosols) is methyl iodide, albeit at low concentration.

34846 **(DOE/SF/70030—T45) Blowdown transients and implication for leak protection shutdown strategy.** Magee, P.M. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Apr 1980. Contract AT03-76SF70030. 32p. NTIS, PC A03/MF A01. Order Number DE81027453.

The creep-fatigue damage due to a blowdown transient is independent of the rate of water-side blowdown following isolation. The damage depends primarily upon plant system characteristics which set the rate of IHTS sodium cooldown after reactor scram and main pump trip. The time delay between a small leak alarm and reactor scram should be considered as a tradeoff between (1) providing time to confirm the existence of the leak to a reasonable level of assurance and (2) the potential for secondary tube wastage damage. In general, there appears to be no incentive to delay water-side blowdown following scram because the additional stress damage due to blowdown is insignificant and the potential for wastage damage should be eliminated as quickly as possible. One exception is the case of multiple evaporators feeding a superheater (as for CRBRP) where isolation and blowdown of one evaporator shortly after scram can cause significant additional stress damage to the superheater upper tubesheet. When initiated, the water-side blowdown process should be rapid. About 30 seconds blowdown time appears practical and adequate, based on the CRBRP design.

34847 **(DOE/SF/71032—T39) Risk allocation approach to reactor safety design and evaluation.** Gokcek, O.; Temme, M.I.; Derby, S.L. (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). 1978. Contract AT03-76SF71032. 12p. NTIS, PC A02/MF A01. Order Number DE81026435.

This paper describes a risk allocation technique used for determining nuclear power plant design reliability requirements. The concept of risk allocation-optimum choice of safety function reliabilities under a maximum risk constraint - is described. An example of risk allocation is presented to demonstrate the application of the methodology.

34848 **(EPRI—217-2-4) Probabilistic safety analysis. Interim report 1.** Erdmann, R.C. (Science Applications, Inc., Palo Alto, CA (USA)). Jul 1975. 138p. NTIS, PC A07/MF A01. Order Number DE82900112.

This report summarizes work carried out during the first year of the Science Application, Inc. (SAI)/Electric Power Research Institute (EPRI) contract on LWR probabilistic safety analysis. A large amount of useful source material was provided by the draft report of the Reactor Safety Study (WASH-1400), and much of the SAI activity during the past year was based upon the Study's methods, data, and results. The performance of a sensitivity analysis to determine which systems contribute significantly to overall risk in a BWR is analyzed. Consequence analyses are presented for a PWR and a BWR for each of the accident categories given in WASH-1400, followed by the SAI accident sequence calculations. The development of the BAM code for analyzing logic diagrams and its comparison with existing codes is then presented. The final chapter describes a failure data gathering activity necessary to the reliability analyses conducted.

34849 **(EPRI-NP—225) Study of Zircaloy 4: steam oxidation reaction kinetics. Final report.** Biederman, R.R.; Ballinger, R.G.; Dobson, W.G. (Worcester Polytechnic Inst., MA (USA)). Sep 1976. 99p. NTIS, PC A05/MF A01. Order Number DE82900058.

Experimental studies utilizing a Gleeble have been performed to evaluate the oxidation of reactor grade Zircaloy-4 tubing in steam under both isothermal and transient oxidizing conditions. Metallographic examination including measurements of oxide, stabilized $\alpha$ and $\xi$ thicknesses has been used as the principal method of characterizing the extent of oxidation and in the development of reaction rate kinetics. A variety of test specimens have been analyzed by alternative methods including weight gain analysis, total oxygen analysis by vacuum fusion and high resolution neutron activation analysis as a check on the metallographic method.

34850 **(EPRI-NP—385-Vol.2) One-third-scale air-water pump program: alternate pump performance data.** Meerbaum, M.I. (Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Generation Div.). Dec 1977. 574p. NTIS, PC A24/MF A01. Order Number DE82900008.

The performance characteristics of a one-third-scale reactor coolant pump operating in steady-state under single- and two-phase conditions were derived from a test program executed by the Bingham-Willamette Company in conjunction with The Babcock and Wilcox Company. Air-water mixtures with temperatures ranging from 58 to 118F, pressures ranging from 5 to 95 psig, and void fractions between 0 and 90% were supplied to the pump at flow rates as high as 1.06 times the nominal pump capacity of 11,200 gpm by the test loop. A digital computer code, PRTWRIA, was written in Fortran language for use on the CDC-7600 computer to reduce the measured data and present calculated parameters pertinent to the understanding of two-phase pump performance.

34851 **(EPRI-NP—526(Vol.4.Pt.1)) Transient deformation properties of Zircaloy for LOCA simulation. Final report.** Mohr, C.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1980. Contract AC06-76RL01830. 525p. NTIS, PC A22/MF A01. Order Number DE82000496.

This experimental data report is Volume 4 of a series of 5 volumes describing the oxidation and deformation rate behavior of Zircaloy cladding under simulated LOCA conditions. It contains listings of strain versus stress, time, and temperature evaluated from the numerical constitutive relationships and the original data used to develop them. This volume also contains listings of the ramp load, pressure, and temperature test data from both current and previous phases of the series, as well as material describing applications of the data.

34852 **(MIT-EL—80-005) Development of computer code models for analysis of subassembly voiding in the LMFBR.** Hinkle, W. (ed.). (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Dec 1979. Contract AS02-76EV02428. 163p. NTIS, PC A08/MF A01. Order Number DE81030520.

Two codes are being developed in parallel. The first will use a two fluid (6 equation) model which is more difficult to develop but has the potential for providing a code with the utmost in flexibility and physical consistency for use in the long term. The other will use a mixture (<6 equation) model which is less general but may be more amenable to interpretation and use of experimental data and therefore, easier to develop for use in the near term. To assure that the models developed are not design dependent, geometries and transient conditions typical of both foreign and U.S. designs are being considered. In addition to the code development, a study is being conducted which is aimed at obtaining a basic understanding of flow oscillations observed in low-power, low-flow sodium boiling experiments conducted at ORNL using the THORS test facility. This study includes water tests to simulate low power low flow sodium boiling flow oscillations and development of an analytical model to predict the oscillations. During FY1979 an effort has also been made to coordinate this program with other related DOE sponsored programs and activities concerned with sodium boiling R and D.

34853 **(NUREG/CP—0014(Vol.1)) Proceedings of the ANS/ASME/NRC international topical meeting on nuclear reactor thermal-hydraulics: PWR and BWR reactor-plant performance analysis and containment technology.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). 1980. 806p. (CONF-801002—(Vol.1)). NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Separate abstracts are included for each of the papers presented concerning blowdown and refill of pressurized-water reactors; thermal hydraulics of boiling-water reactors; BWR pressure suppression containment technology; PWR containment technology; thermal hydraulics of reactor components; and flow-induced vibration of reactor components. Seven papers have been previously abstracted and input to the data base.

34854 (NUREG/CP—0014(Vol.1), pp 1-63) **Thermal hydraulics related to reactor safety.** Hsu, Y.Y. (Nuclear Regulatory Commission, Washington, DC). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The most critical concern of reactor safety is the availability of cooling capability, be it the coolant inventory or the ECC (Emergency Core Cooling) capability. Thus, thermal hydraulics of the reactor coolant is one of the most important topics of reactor safety. Many thermal hydraulic issues are encountered in postulated accident scenarios. The scenarios for major LOCA (Loss of Coolant Accidents) and for small break accidents are presented. Information is presented concerning interfacial heat transfer; interfacial mass transfer; and system effects.

34855 (NUREG/CP—0014(Vol.1), pp 93-112) **Modeling of non-equilibrium effects during blowdown and refill of a PWR vessel.** Crowley, C.J.; Wei, S.; Rothe, P.H. (Creare Inc., Hanover, NH). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

This paper presents experiments and analysis of nonequilibrium flow situations during blowdown of scale-model PWR vessels with simulated Emergency Core Coolant (ECC) injection. Experiments were performed in a 1/15-scale model at pressures up to 700 kPa and in a transparent 1/30-scale vessel at low pressure (200 kPa). The particular phenomena of phase slip in the flashing vessel mixture and interaction of subcooled water with steam from flashing are examined here. RELAP4/MOD5 calculations are compared with data for blowdown experiments without ECC injection. Of several slip velocity models, the Wilson correlation best describes

phase slip in these experiments. A semi-empirical analysis is successfully compared with experimental data for blowdowns with and without ECC injection.

**34856** (NUREG/CP—0014(Vol.1), pp 146-154) **Improvement in the RELAP4 ECC bypass model.** Kern, R.C. (Nuclear Associates International, Rockville, MD); Hsu, M. 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

RELAP4 is a thermal-hydraulic code which predicts the transient response of a nuclear power plant subjected to postulated accidents such as a loss of coolant (LOCA). When loss of coolant occurs, the Emergency Core Cooling System (ECCS) will respond automatically and the cold water from accumulators and high and low head pumps is injected into the reactor core. The ECC bypass model currently used in RELAP4 is a conservative approach which removes the total amount of injected water (up to the end of bypass) from the reactor coolant system and replaces it with saturated steam. A new model, which is consistent with the current model yet gives a better prediction of ECC water distribution, is presented in this paper. This model, which calculates the distribution of ECC water in the reactor coolant system, only removes the amount remaining.

**34857** (NUREG/CP—0014(Vol.1), pp 257-292) **Pressure suppression containment thermal-hydraulics state of the art.** Moody, F.J. 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Pressure suppression containment has been the subject of analysis, research, and development in the United States and other countries for over two decades. However, evolution of the technology has accelerated substantially from the mid-seventies to the present time, providing many new insights to system responses during a loss of coolant event. This paper presents a brief summary of pressure suppression which extends from early pressurization loads to recent studies of unsteady condensation and other short time response phenomena.

**34858** (NUREG/CP—0014(Vol.1), pp 293-302) **Studies on the dynamic phenomena caused by steam condensation in water.** Arinobu, M. (Toshiba Corp., Kawasaki, Japan). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Dynamic phenomena caused by steam injection into water have been investigated experimentally. These phenomena are supposed to occur in light water reactor pressure suppression pools. The condensation phenomena are classified mainly by steam velocity and water temperature. In the case of higher steam velocity, periodic pressure oscillation is produced. Its dominant frequency is expressed by an empirical equation. In the case of lower steam velocity, chugging phenomena may occur. The influence of the parameters on the wall pressure amplitude have been investigated statistically. Vent pipe vibrations and methods for reducing the pressure amplitudes have also been investigated.

**34859** (NUREG/CP—0014(Vol.1), pp 303-318) **Pressure suppression tests in a large scale 3 vent arrangement.** Aust, E.; Schwan, H.; Vollbrandt, J. (GKSS-Forschungszentrum Geesthacht-Tesperhude, Germany). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Within the reactor safety research program GKSS performs pressure suppression experiments in a large scale three-vent arrangement. Main objectives of these experimental studies are vent clearing, chugging phenomena, their simultaneity in a multiple vent configuration and induced loads to wetwell structures. First tests show chugging events within a time interval of approximately 10 milliseconds at the 3 vent pipes. They induce pressure pulses. High speed films time correlated to pressure signals indicates the mechanism of chugging phenomena.

**34860** (NUREG/CP—0014(Vol.1), pp 319-343) **Scale-modeling thermal-hydraulic phenomena in nuclear containment.** Moody, F.J. (General Electric Co., San Jose, CA). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A proposed systematic procedure is formulated for the design of scale model experiments to study heat, thermodynamic, and fluid phenomena in nuclear containments. The procedure provides a means of determining which significant physical effects must be preserved and which effects can be neglected in a scale model experiment. It also shows when a system cannot be scaled. Model laws obtained in several examples are confirmed by comparison wth experiments.

**34861** (NUREG/CP—0014(Vol.1), pp 344-360) **Evaluation of vertical forces on BWR containment by an improved scaling method.** Utamura, M.; Yokoyama, I. (Hitachi Ltd., Ibaraki, Japan). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Scale model experiments are carried out to determine characteristic of vertical forces imposed on a BWR suppression chamber during air clearing phase of a loss of coolant accident. This paper discusses following items: (1) improvement on scaling the vent gas flow; (2) evaluation of load oscillations owing to fluid-structure interaction; and (3) variation of magnitude of peak loads with the number of downcomers increased.

**34862** (NUREG/CP—0014(Vol.1), pp 361-377) **Investigation of distorted geometry simulation of pool dynamics in horizontal-vent BWR containments.** Ruggieri, N.G.; Sonin, A.A. (Massachusetts Inst. of Tech., Cambridge). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Experiments were conducted to investigate the accuracy of distorted geometry testing of pool dynamics in horizontal-vent BWR containments. Distorted-geometry testing implies testing in systems where the flow-wise dimensions are full scale, but all dimensions transverse to the flow are reduced in the same proportion. The assumption is that flow velocities, pressures and other thermodynamic properties will be the same in the distorted-geometry system as in its correctly proportioned counterpart. The experiments, which were done at small scale using the established scaling laws, showed that the geometric distortions can have a significant effect on the pool swell under conditions which are roughly representative of horizontal-vent BWR containment systems during a LOCA. Breakthrough occurred later, the water ligament was thicker, and pool velocity lower in a system where the cross-sectional areas were reduced by a factor of three. Some reasons for the differences are discussed.

**34863** (NUREG/CP—0014(Vol.1), pp 378-398) **Perturbation analysis of fluid-structure interactions in a model test system.** Huber, P.W.; Kalumuck, K.M.; Sonin, A.A. (Massachusetts Inst. of Tech., Cambridge). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A perturbation analysis of fluid-structure interactions in a model test system of controlled flexibility excited by a complex hydrodynamic transient is presented. The analysis demonstrates the important features of the perturbation method and its implementation. Comparison of predictions with experiment provides a test of the analytical procedure and its underlying assumptions. The results illustrate the important effect of transient liquid mass redistribution on the flexible system response.

**34864** (NUREG/CP—0014(Vol.1), pp 400-415) **Condensation heat transfer coefficients in LWR-containments during LOCA.** Schwan, H.; Aust, E. (GKSS-Forschungszentrum Geesthacht-Tesperhude, Germany). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Best estimate calculations in nuclear safety analysis require replacement of conservative assumptions by measured data or verified correlations. In the field of containment response analysis this holds for condensation heat transfer coefficients at containment structures. In a large scale pressure suppression test facility heat transfer coefficients are determined at structures of the drywell in order to get data representative for break compartments of LWR-containments. Experimental results show heat transfer coefficients of the order $10^4$ $W.m^{-2}.K^{-1}$ even at presence of noncondensable gas.

34865 (NUREG/CP—0014(Vol.1), pp 429-461) **Numerical calculation of pressure wave propagation and loading resulting from the postulated burst of a spherical PWR-steel containment during the pressure test.** Koch, V. (Technischer Ueberwachungs-Verein Baden e.V., Mannheim, Germany); Pohl, W. 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

With the help of the numerical calculation program PISCES-2 DELK pressure wave propagation phenomena are calculated with regard to the postulated failure of the containment during the pressure test. The failure mechanism is presupposed to be due to spontaneous failure on the one hand and a temporal given way of the opening function on the other hand. The propagation calculations with regard to pressure, velocity and contours of material have been made 1-dimensional, that is to say, spherosymmetrical, as well as 2-dimensional with one unit depth. In the so-called near region especially the interaction between fluid and structure is tested whereas in the far region the pressure-time-histories are of special interest. A comparison of the numerical results has shown that the 1-dimensional pressure wave propagation corresponds with the theory of linear shock waves.

34866 (NUREG/CP—0014(Vol.1), pp 504-534) **Experimental determination of the two-phase flow distribution at the tube sheet of a model PWR steam generator.** Howard, R.C.; Hochreiter, L.E. (Westinghouse Electric Corp., Pittsburgh, PA). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

This paper presents the results of a series of air/water flow tests run on two model steam generator inlet plenums. The tests measured the two-phase flow distribution at the entrance region of each of the 32 tubes in the model steam generator tube bundle. The test superficial velocity boundary conditions are representative of steam generator inlet plenum conditions during the reflood phase of a large loss of coolant accident transient. The first test series was run on a 1/10 scale model of a vertical U-tube steam generator inlet plenum. The second model plenum was a long cylindrical plenum identical to the inlet plenum of the FLECHT-SEASET model steam generator.

34867 (NUREG/CP—0014(Vol.1), pp 565-584) **Thermodynamic model of centrifugal pump performance in two-phase flow.** Zarechnak, A.; Damerell, P.; Chapin, D.; Wu, D. (MPR Associates, Washington, DC). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Accurate predictions of pump performance including head, torque, flow and speed under two-phase steam/water flow conditions are required for analysis of postulated loss-of-coolant accidents in a nuclear reactor. Accordingly, a thermodynamic model of centrifugal pump steady state performance in two-phase steam/water flow has been developed and compared to several sets of measured data. The model predicts the head across the pump for two-phase flow on the basis of pump torque, pump speed, inlet fluid conditions and the efficiency when pumping single-phase fluid. The change in pressure across the pump is determined by calculating changes in entropy and enthalpy across the pump. The dependence of the model on the specific pump is through the use of the pump efficiency when pumping single-phase fluid and measured pump torque in two-phase flow. Pump model predictions have been compared successfully to results of tests for four different pumps of varying scale.

34868 (NUREG/CP—0014(Vol.1), pp 585-607) **Behaviour of centrifugal pumps in steady and transient steam-water flows.** Heidrick, T.R. (Atomic Energy of Canada Ltd., Pinawa, Manitoba); Rajan, V.S.V.; Nguyen, D.M. 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

This paper describes the results of steady and transient two-phase flow experiments done with a single stage centrifugal pump that has a specific speed similar to that of a CANDU nuclear reactor pump N/sub s/ = 2370 (RPM) (GPM)/sup 1/2/ (ft)/sup -3/4/. THe steady flow experiments were done with forward impeller rotation and both forward (i.e., normal) and reverse flow directions. Transient steam-water flows were produced by depressurizing a loop that contained the test pump and a large reservoir initially filled with subcooled water. Measurements included steam and water flow rates, mixture densities upstream and downstream of the pump, and differential pressures across the pump. These results are compared to tests done on a pump that was of similar size, but had a lower specific speed and hence a different impeller geometry.

34869 (NUREG/CP—0014(Vol.1), pp 608-662) **Some advances in the thermal hydraulics of reactor components.** Cumo, M. (Comitato Nazionale per l'Energia Nucleare, Rome, Italy). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A state of the art review on the thermal-hydraulics of reactor components is a really difficult task since this discipline has reached, in recent years, the dimensions and the deepness of a true, independent science. All the themes and methods of classic thermal and hydraulic sciences are applied and tested in a series of rather unusual situations which, for the first time, have arisen. The headings in which research work may be subdivided are the following: pressure drops; transient two-phase flows; shell-and-tube heat exchangers; two-phase cross flows through tube bundles; heat transfer correlations and modelling for steam generators; and loss-of-coolant accidents in reactor primary circuits.

34870 (NUREG/CP—0014(Vol.1), pp 707-732) **Shell model in-water frequencies of the core barrel.** Takeuchi, K.; De Santo, D.F. (Westinghouse Electric Corp., Pittsburgh, PA). 1980. NTIS. Order Number DE81903587.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Natural frequencies of a 1/24th-scale core barrel/vessel model in air and in water are measured by determining frequency responses to applied forces. The measured data are analyzed by the use of the one-dimensional fluid-structure computer code, MULTIFLEX, developed to calculate the hydraulic force. The fluid-structure interaction in the downcomer annulus is computed with a one-dimensional network model formed to be equivalent to two-dimensional fluid-structure interaction. The structural model incorporated in MULTIFLEX is substantially simpler than that necessary for structural analyses. Proposed for computation of structural dynamics is the projector method than can deal with the beam mode by modal analysis and the other shell modes by a direct integration method. Computed in-air and in-water frequencies agree fairly well with the experimental data, verifying the above MULTIFLEX technique.

34871 (NUREG/CP—0014(Vol.2), pp 857-873) **Investigation of highly accelerated two-phase flow in a nozzle.** Kedziur, F. (Kernforschungszentrum, Karlsruhe, Germany). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A two-phase flow experiment is described in detail: the stationary flow of a steam-water mixture at pressures up to 13 MPa and temperatures up to 600K through a converging nozzle. The experiment is especially designed for verification and assessment of advanced two-phase computer codes, which find application in reactor safety analysis, in particular in LOCA blowdown calculations. The shape of the nozzle, the instrumentation and the experimental program are such that models and empirical parameters of a wide range of codes can be tested and determined, respectively. Results show the influence and magnitude of models and parameter

variations, the effect of the dimensionality of the code and the relevance of the models as a function of the initial conditions.

34872 (NUREG/CP—0014(Vol.2), pp 874-889) **Measurement of void distributions in a horizontal pipe during blowdown by x-ray beam scanning method.** Kagawa, T.; Ishizuka, T.; Narabayashi, T.; Tokuyama, K. (Toshiba Corp., Kawasaki, Japan). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

In order to measure void distributions across channel flow during blowdown from a high pressure water vessel to atmosphere, we have developed a new technique using a scanning x-ray beam and computer system. As a result of the experiment, it was shown that the system is effective to measure the local void distribution in a channel, especially in transient condition. Data as to how flow pattern changes during the blowdown in the upstream of the choke point were obtained.

34873 (NUREG/CP—0014(Vol.2), pp 890-902) **Assessment of the critical flow models of RELAP4/MOD6 and TMOC codes.** Siikonen, T.; Holmstroem, H. (Nuclear Engineering Lab., Helsinki, Finland). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Experiences of the critical flow models of RELAP4/MOD6 and TMOC codes are presented. The calculations have been carried out by using the data of the Marviken full scale critical flow tests. The work focused on analyzing the effects of fluid subcooling, nozzle geometry, system nodalization and different critical flow model options. Generally, predictions compare rather well with experimental data. Care is needed, however, in choosing the nodalization and values for certain input options of the codes.

34874 (NUREG/CP—0014(Vol.2), pp 904-922) **Preliminary study of the application of reconstruction tomography to void fraction measurements in two-phase flow.** Kulacki, F.A.; Schlosser, P.A.; DeVuono, A.C.; Munshi, P. (Ohio State Univ., Columbus). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

An experimental study has been conducted to determine the utility of reconstruction tomography, as currently practiced in nuclear medicine, in the measurement of void fraction and average density in two-phase flow. A bubbly air-water flow has been used in this study, and the measurement of the void across a plane in the flow has been made with a static analog of an instrument using a rotating, fan-beam source of gamma rays. Excellent results are obtained for average density reconstructed from fan-beam data over a 100 s scan time. Sources of error are identified and partially quantified in both the present experiments and an instrument prototype. The general features of a prototype rotating fan-beam densitometer are described and its major design specifications are enumerated.

34875 (NUREG/CP—0014(Vol.2), pp 923-933) **Basic two-phase flow measurements using $^{16}N$ tagging techniques.** Perez-Griffo, M.L.; Block, R.C.; Lahey, R.T. Jr. (Rensselaer Polytechnic Inst., Troy, NY). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A simple mixing model has been developed to analyze the fine structure observed in vertical slug-flow data obtained using $^{16}N$ tagging techniques. This model assumes perfect mixing within the liquid slug for a steady-state, fully-developed, adiabatic, air/water slug-flow. It is shown that the normalized $^{16}N$ concentrations in successive slugs follow a Poisson distribution. Experimental evidence is also presented for the disappearance of the laminar boundary layer near the pipe wall for a two-phase flow condition having a very small air flow.

34876 (NUREG/CP—0014(Vol.2), pp 970-981) **Experience with steam temperature and water detection probes for transient mist flow in hot rod bundles.** Ihle, P.; Mueller, St. (Kernforschungszentrum, Karlsruhe, Germany). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Measurements were conducted of the coolant phase temperatures in a two-phase flow environment and in the presence of thermal radiation fields. Fast responding thermocouples and high frequency water detection probes were used to measure directly the local coolant quality above the quench front during reflooding experiments. The particular measurements and phenomena discussed are those of the steam superheat, presence and distribution of water as well as droplet velocity.

34877 (NUREG/CP—0014(Vol.2), pp 982-998) **Mass flow rate measurements in horizontal steam-water flow with a drag disc turbine transducer, a gamma densitometer and the radiotracer technique.** Reimann, J. (Kernforschungszentrum, Karlsruhe, Germany); John, H.; Loeffel, R.; Solbrig, C.W.; Chen, L.L.; Good, R.R. Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

This paper describes experiments in horizontal, separated steam-water flow at pressures up to 75 bars, with two different instrumentation methods used to measure two-phase mass flow rate; the one consists of a drag disc turbine transducer (DTT) and a gamma densitometer, the other uses the injection and detection of radiotracers and a gamma densitometer. Single instrument readings and evaluated mass flow rates are discussed as a function of phase distribution. Different models are used for mass flow rate evaluation with the combination DTT-gamma densitometer, including a calibration procedure for separated flow regimes.

34878 (NUREG/CP—0014(Vol.2), pp 999-1018) **Analysis of a drag-disk in transient two-phase flow.** Kamath, P.S.; Lahey, R.T. Jr. (Rensselaer Polytechnic Inst., Troy, NY). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

An analytical model incorporating the effects of velocity and void profiles, drag, slip, spring stiffness and the transient effects of inertia, damping and virtual mass has been developed. This model can be used to calculate the transient mass flux of a two-phase fluid flowing in a conduit instrumented by a free-field drag-disk transducer. It is shown that for many cases of interest the transient effects are unimportant, thus a quasisteady solution technique can be employed to calculate the transient mass flux without appreciable error.

34879 (NUREG/CP—0014(Vol.2), pp 1019-1042) **Boiling heat transfer mechanisms in reactor thermal-hydraulics.** Bergles, A.E. (Iowa State Univ., Ames). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

This review discusses basic boiling heat transfer mechanisms of interest to boiling water reactor and pressurized water reactor thermal-hydraulics. Included are the present understanding and recent advances in incipient boiling, nucleate boiling, burnout, post dryout, and quenching. Brief mention is made of other heat transfer processes of interest to reactor operation under normal and fault conditions.

34880 (NUREG/CP—0014(Vol.2), pp 1043-1091) **DNB location with axially disuniform heat flux profiles and flow obstructions: an experimental contribution.** Cumo, M.; Palazzi, G. (Comitato Nazionale per l'Energia Nucleare, Rome, Italy). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Safety requirements for LWR's become more and more severe. So, further information is needed about the influence on the

DNB level of axial heat flux disuniformities and local obstructions which accidentally may block, partially or totally, the flow area, following different incidental mechanisms (deposition, ballooning, rod bowing, etc.). As it is well known many mixing codes have been developed up to now, based on different hypothesis which physically cannot be valid any more if abrupt changes are formed along the flow area. Two phase flow DNB mechanisms also may be greatly influenced by different types of heat flux profiles and flow obstructions. So the whole channel through which the two phase mixture flows may exhibit a different behaviour for what pertains to the thermal crisis, both for the value of the critical power and the location of the DNB point. For this, an experimental investigation has been performed, employing freon 12 as water-scalar-fluid and a four rod bundle test section.

34881 (NUREG/CP—0014(Vol.2), pp 1092-1110) **Experimental study of dryout heat transfer in tubes by a temperature transient method.** Green, W.J.; Lawther, K.R. (AAEC Research Establishment, Sutherland, Australia). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Heat transfer characteristics associated with a change from pre-dryout to post-dryout conditions have been investigated using vertical round tube test sections. These were heated by passing electric current along the tube wall and cooled by passing Freon-12 upwards through the tube. A short downstream section of the heated tube, with a separately controlled power supply, provided the power transient condition in which an increase in power input would result in a change to post-dryout conditions, whereas the upstream section was maintained at a constant heat flux just below the onset of dryout. Post-dryout heat transfer characteristics were deduced from wall temperature responses measured in the downstream section.

34882 (NUREG/CP—0014(Vol.2), pp 1111-1130) **Spacing devices for nuclear fuel bundles: a survey of their effect on CHF, post-CHF heat transfer and pressure drop.** Groeneveld, D.C. (Chalk River Nuclear Labs., Ontario); Yousef, W.W. Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The thermohydraulic aspects of spacing devices for water-cooled nuclear fuel bundles have been studied in many laboratories. The results show that spacing devices can have large effects on CHF. The effects are usually positive but negative effects on CHF are feasible with ill-designed spacing devices. Bundle pressure drops are usually increased significantly by the presence of spacers. In the post-CHF region, the improved subchannel mixing and the extra turbulence generated by spacing devices enhance the heat transfer coefficient, especially in the region just downstream of the spacers. Significant positive effects of spacing devices on heat transfer during rewetting can be inferred from the limited information available.

34883 (NUREG/CP—0014(Vol.2), pp 1131-1141) **Boiling curve in high quality flow boiling.** Shiralkar, B.S. (General Electric Co., San Jose, CA); Hein, R.A.; Yadigaroglu, G. Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The post dry-out heat transfer regime of the flow boiling curve was investigated experimentally for high pressure water at high qualities. The test section was a short round tube located downstream of a hot patch created by a temperature controlled segment of tubing. Results from the experiment showed that the distance from the dryout point has a significant effect on the downstream temperatures and there was no unique boiling curve. The heat transfer coefficients measured sufficiently downstream of the dryout point could be correlated using the Heineman correlation for superheated steam, indicating that the droplet deposition effects could be neglected in this region.

34884 (NUREG/CP—0014(Vol.2), pp 1142-1160) **Analysis of blowdown heat transfer experiments and critical heat flux.** Leung, J.C.M. (Argonne National Lab., IL); Gallivan, K.A. Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The objective of this study is to conduct a careful analysis of blowdown heat transfer experiments and their associated critical heat flux (CHF) phenomena. A simple thermal-hydraulic code was developed to calculate local fluid conditions with appropriate boundary input from experimental measurements. Calculation results were checked against measured data which have not been used in the input and generally good agreement was obtained. The prediction of CHF is based on the assumption of instantaneous local conditions hypothesis. Both CISE and Biasi correlations were shown to correlate the early CHF well while the Griffith-Zuber low-flow correlation was credited with the prediction of delay CHF.

34885 (NUREG/CP—0014(Vol.2), pp 1161-1172) **PWR setpoint philosophy and methodology.** Wang, O.S. (Washington Public Power Supply System, Richland). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

This paper is intended to discuss the general bases for pressurized water reactor (PWR) setpoints, and to present part of the activities at the Washington Public Power Supply System to develop in-house methodology for generating safety limits and associated system settings. The setpoints along with the procedures to establish operating technical specifications are designed to prevent fuels and reactor coolant boundaries from exceeding design safety limits during operation at various mode. A summary of the bases for reactor safety and a number of working examples to obtain safety limits and system settings are given in the text. The related thermal-hydraulic computer codes used as analytical tools are available in the public domain and widely accepted by the nuclear utilities and industry.

34886 (NUREG/CP—0014(Vol.2), pp 1173-1195) **Analytical modeling of heat transfer during the reflooding phase of the LOCA: the UCFLOOD code.** Yadigaroglu, G.; Arrieta, L.A. (Univ. of California, Berkeley). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A mechanistic model of bottom-reflooding heat transfer is described. From the hydrodynamic point of view the flow channel is divided into a single-phase liquid region, a continuous-liquid two-phase region, and a dispersed-liquid region. The void fraction is obtained from drift flux models. The onset of liquid entrainment is determined using a criterion based on the instability of the liquid core in the inverted-annular flow regime. For heat transfer calculations, the channel is also divided into a number of regions. The heat transfer coefficients are functions of the local flow conditions. Quench front propagation is treated separately by a model including the effects of axial conduction. Good agreement of calculated and experimental results has been obtained.

34887 (NUREG/CP—0014(Vol.2), pp 1196-1216) **Thermal-hydraulics of the bottom reflooding in tubes with different thickness and length.** De Salve, M.; Panella, B. (Politecnico di Torino, Italy). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

In order to investigate the transient heat transfer modes and fluid flow regimes which can be encountered during rewetting of very hot surfaces a set of reflooding experiments with several tubular test sections have been performed. The contribution of the present study is that it presents the experimental results obtained during reflooding tests with AISI 316 (10 mm I.D.) electrically heated tubes of 1 m and 1.5 m length and 1 mm and 1.5 mm thickness. Heat flux to the coolant, heat transfer coefficient, quench temperature, quench time and average rewetting velocity, liquid and fluid temperatures at the outlet of the channel are evaluated from the measured data over a wide range of experimental parameters.

**34888** (NUREG/CP—0014(Vol.2), pp 1217-1236) **Investigation of flooding phenomena in an experiment related to the PWR problem.** Simpson, H.C.; Rooney, D.H. (Univ. of Strathclyde, Glasgow, Scotland). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Flooding experiments have been carried out on 1/10 scale models of the annular space of a PWR using both air and steam rising against water and with the water injected either tangentially or normally to the test section. The effect of steam condensation is shown to modify the flow pattern, and hence the flooding mechanism, for the tangential injection case and a theory is presented of this flooding process. The method of water injection is shown to modify the flow pattern with steam-water mixtures and hence the conditions for water bypass. The results of the normal injection tests are included since they were found to be in general agreement with those of other workers.

**34889** (NUREG/CP—0014(Vol.2), pp 1237-1251) **Heat transfer and fluid flow during reflooding of blocked arrays.** Rust, K.; Ihle, P. (Kernforschungszentrum, Karlsruhe, Germany). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Reflooding tests have been conducted using a 1 x 5 array as well as a 5 x 5 array of electric heater rods to study reflood phenomena. The main purposes of the tests are to measure and evaluate the influence of size and shape of coolant channel blockages on the heat transfer conditions and on the two-phase flow within a PWR core during the reflood phase of a LOCA. All experiments performed so far lead to the conclusion, that under forced flow conditions uniform coplanar blockage of all subchannels in the 5 rod row as well as partial blockage with by-pass flow in a 5 x 5 rod bundle do not result in a significant increase in the clad temperatures upstream or downstream of the blockage.

**34890** (NUREG/CP—0014(Vol.2), pp 1252-1265) **Studies on the significance of radiant heat transfer in the fuel assembly under LOCA conditions.** Jokela, M.L.; Ollikkala, H. (Nuclear Engineering Lab., Helsinki, Finland). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A computer code MOXY-VVER has been developed to analyze radiant heat transfer in a hexagonal fuel rod assembly. The code applies a two-dimensional temperature solution for the fuel rods. Calculations carried out indicate that the average surface temperature of the fuel rod decreases significantly in comparison with the non-radiation case and that circumferential temperature variations on rod surface can amount up to 30 K.

**34891** (NUREG/CP—0014(Vol.2), pp 1288-1330) **Two-phase hydrodynamics: models and mechanisms.** Banerjee, S. (McMaster Univ., Hamilton, Ontario). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Hydrodynamic aspects of models for transient two-phase flow are discussed. The predictive capabilities of these models are shown to depend on a knowledge of the flow regimes involved. Therefore, methods for identifying flow regimes and predicting transitions, including countercurrent flow limitations, are also discussed. Areas where more work is necessary, such as flow regimes and void distribution during boiloff, reflux condensation and natural circulation, are identified. The models developed are then applied to particular situations to illustrate their strengths and weaknesses. If flow regimes are known, their predictions are satisfactory for the cases of refilling and rewettting, and pressure wave propagation. For a description of finite amplitude waves in two-phase flow, the analysis indicates that higher order dispersive and dissipative terms may have to be incorporated. An interesting result of this is that waves of permanent shape may arise in two-phase flows.

**34892** (NUREG/CP—0014(Vol.2), pp 1331-1342) **Flow regime dependent model of two-phase flow.** Gay, R.R. (Rensselaer Polytechnic Inst., Troy, NY); Statile, D. Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A flow regime dependent model of fully developed, adiabatic, two-phase vapor/liquid flow in circular channels has been developed. A Computer Program based upon the model may be used to predict for given values of void fraction and pressure gradient the mass flow rates and velocities of each subflow (vapor, droplets and liquid film). The predictions of this computer program are compared to correlations and to experimental data.

**34893** (NUREG/CP—0014(Vol.2), pp 1343-1362) **Evaluation of two bubble-detachment models for two-phase flow.** Beattie, D.R.H. (AAEC Research Establishment, Sutherland, Australia). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Two-phase flows with attached wall bubbles are considered as flows in roughened ducts with roughness elements equal in magnitude to the bubble detachment diameters determined by a force balance analysis. Two methods for determining the drag component of the forces acting on a bubble give distinctly different mixing-length theory expressions for velocity profile, friction factor, and void fraction. Available data are shown to be compatible with that set of expressions in which drag is due primarily to skin friction rather than form drag.

**34894** (NUREG/CP—0014(Vol.2), pp 1363-1383) **Turbulence structure of a co-current air-water bubbly flow.** Lance, M.; Marie, J.L.; Charnay, G.; Bataille, J. (Ecole Centrale de Lyon, France). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The present work is an experimental study of the turbulence structure of a co-current air-water bubbly flow, flowing upward in a vertical channel. With the exception of Serizawa's and Sullivan's pioneering contributions, this particular but important aspect of two-phase flow considered herein, the authors have tried to provide as detailed and complete a description of turbulence in the liquid phase, as one would expect nowadays for single phase flows. The influence of the presence of air bubbles on the various standard local parameters characterizing turbulence has been examined, namely the turbulent intensity, the skewness and flatness factors of the velocity fluctuation and its time derivative, the one dimensional spectrum.

**34895** (NUREG/CP—0014(Vol.2), pp 1418-1436) **Stability of quasi-stable film boiling and the behavior of the vapor film to a quenching initiation on a horizontal wire in subcooled water.** Mori, M.; Toda, S. (Tohoku Univ., Sendai, Japan). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A basic study has been performed to investigate the behavior of the vapor film from stable film boiling to quenching initiation on a heated horizontal platinum wire in subcooled water. A He-Ne gas laser beam is used for measuring the vapor film thickness and its time variation. The vapor film fluctuation and its dominant frequency are strongly affected by the heat flux and the coolant subcooling temperature. Under highly subcooled conditions, the vapor film fluctuation is much suppressed shortly before stable film boiling collapses. The heat flux at which its collapse occurs shifts to a higher value with increasing subcooling temperature.

**34896** (NUREG/CP—0014(Vol.2), pp 1463-1483) **Film entrainment and drop deposition for two-phase flow.** Koestel, A.; Gido, R.G.; Gilbert, J.S. (Los Alamos Scientific Lab., NM). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A model for estimating the rate of film mass entrainment for drop-annular flow, based on film disturbance wave stability, was

developed. The model was verified by application to tests involving deposition and entrainment. To account for the deposition, a recent particle mass diffusion correlation was used. Application of the entrainment and deposition models confirmed that a flow passage length (L/D) of about 100 or more is required to achieve near equilibrium, for a zero initial entrainment flow. The assumption of an initially fully entrained flow remaining approximately so, as used in nuclear power plant subcompartment analysis, is shown to be appropriate.

34897 (NUREG/CP—0014(Vol.2), pp 1484-1503) **Droplet motion in two-phase flow.** James, P.W.; Hewitt, G.F.; Whalley, P.B. (Atomic Energy Authority Research Establishment, Harwell, England). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The exprimental measurement of Whalley, Hewitt and Terry and of Hewitt and Whalley on droplet trajectories in annular gas-liquid flow have been extended. The droplets are ejected from disturbance waves on the liquid film at a velocity of about 1 m/s. Calculations of the interactions of the droplets with gas phase turbulent eddies reveal that lage droplets are relatively unaffected by the eddies and proceed to deposit as a result of their initial ejection velocity, whereas for smaller droplets the turbulent eddies have a significant effect. Data for droplet deposition in annular flow were interpreted as a combination of these two processes.

34898 (NUREG/CP—0014(Vol.2), pp 1504-1522) **Experimental study of angular collisions between drops and moving liquid films.** Rockenbach, F.A. (Los Alamos Technical Associates, Inc., NM); Alexander, D.R. Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The splashing of liquid drops on a thin liquid film flowing down an inclined plate was studied using high-speed color cinematography. The direction of the splashes in this experiment was observed to be highly dependent upon tangential velocity. The incoming drop showed a marked tendency to flow to the downstream side of the splash, particularly for high incident angle splashes. Results indicated that it was possible for more liquid to be ejected from a splash than was contained in the original drop. All incoming drops were observed to coalesce and subsequently splash for all plate angles of this experiment. It was hypothesized that there would exist some plate angle beyond which drop reflection would occur. With the exception of the zero degree case (perpendicular collision), no Rayleigh jets were observed to form. The zero degree case had a considerably thicker receiving liquid film than the other cases, and the absence of a Rayleigh jet in certain cases is explained.

34899 (NUREG/CP—0014(Vol.2), pp 1523-1558) **Experimental remarks on sputtering phenomena and droplets generation in falling film rewetting.** Cumo, M.; Farello, G.E.; Furrer, M. (Laboratorio Scambio Termico, Rome, Italy). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The falling film rewetting of hot vertical surfaces is studied with particular reference to the emergency cooling (top spray) of shrouds of BWR assemblies. The flow of falling film is, for the range of interest of parameters (flowrate and subcooling), a rivulet flow. The motion of rivulets has been studied with the aid of visualization techniques, determining empirical relationships for the quenching front velocity and the rivulet's width. The sputtering phenomenon has been analyzed with particular regard to the ejected droplets which greatly increase the liquid surface available for superheated steam condensation, deducing empirical relations as well as the dimensional distribution of droplets.

34900 (NUREG/CP—0014(Vol.2), pp 1559-1579) **Radioisotope method for interfacial area measurements in two-component systems.** Banerjee, S.; Khachadour, A. (McMaster Univ., Hamilton, Ontario). Aug 1980. NTIS. Order Number DE81903588.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

A technique for measuring interfacial area in two-component two-phase flows, based on the transmission of short-range beta or alpha particles, across interfaces is proposed. One of the phases contains the radioisotope source, whereas the other contains scintillating material. For short-range particles, it was hypothesized that the number crossing interfaces would originate from very thin layers that are immediately adjacent and, therefore, would lead to a scintillation rate directly proportional to the interfacial area and radioisotope concentration. A series of experiments to check this hypothesis was done with solid-liquid and liquid-liquid systems of known interfacial area. It was found that the scintillation count rate was independent of the orientation of the interfaces and directly proportional to their area. The count rate was also essentially independent of thickness of the radioisotope-bearing fluid and the solid scintillating material.

34901 (NUREG/CP—0014(Vol.3), pp 1581-1596) **Generalized transient characteristics and capabilities of liquid metal fast breeder reactor fuel and blanket rods.** Coffield, R.D. Jr.; Markley, R.A.; Dickson, P.W.; Anderson, H.C. III. (Westinghouse Electric Corp., Madison, PA). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Reactor core designers must ensure that sufficient temperature margin exists at steady state so that fuel and blanket rod lifetime and safety requirements can be met for both steady state and transient conditions. This paper describes the development of a correlation between the maximum allowable steady state cladding temperatures and transient limits. Various LMFBR fuel types are considered in generalized form over a wide range of rod sizes and initial linear powers for worst case overpower and undercooling events in the upset through faulted ASME transient design code categories. Graphical information is presented which can be readily applied by the designer to determine the transient capability of a particular core design. Corrective action can then be taken early in the design evolution, if necessary, with minimal analysis costs.

34902 (NUREG/CP—0014(Vol.3), pp 1724-1731) **LMFBR thermal-hydraulics.** Fauske, H.K. (Argonne National Lab., IL). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Thermal-hydraulic aspects as they relate to public safety considerations of LMFBRs are emphasized. Discussions include considerations of (1) changing trends in accident prevention and mitigation and (2) nonmechanistic considerations of HCDAs including aspects of fuel-coolant interactions and recriticality events.

34903 (NUREG/CP—0014(Vol.3), pp 1836-1851) **Heterogeneous two-phase flow model BLOW-3A and its relevance for thermal-hydraulic analysis of off-normal conditions in LMFBRs.** Bottoni, M.; Struwe, D. (Kernforschungszentrum, Karlsruhe, Germany). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Experimental and theoretical analyses of sodium boiling behavior performed at the Nuclear Research Center Karlsruhe have led to the development of the computer program BLOW-3A which describes sodium boiling phenomena under accident conditions in one-dimensional geometry by means of a heterogeneous multi-bubble slug ejection model. The main characteristics of the code are explained with particular emphasis on the analysis of the transient fuel behavior and on the methods used for the numerical solution of the set of equations describing the separated phases in the two-phase flow model. Some representative results from the theoretical interpretation of single-pin and 7-pin in-pile and out-of-pile experiments are shown to provide a validation of the theoretical basis of the computer program. Future developments of the model to more-dimensional description of sodium boiling in bundle geometry are presented.

34904 (NUREG/CP—0014(Vol.3), pp 1926-1949) **Evaporation coefficient and pressure transient in incipient boiling of liquid metal.** Fujii-e, Y.; Morita, T.; Inoue, S.; Miyazaki, K. (Osaka Univ., Japan). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

For better understanding of phase transfer process of liquid metal, a boiling experiment of stagnant potassium was conducted to measure evaporation coefficients in a bottle-shape vertical test channel. Observation of boiling transients revealed that the pressure rose up nearly to the saturation level corresponding to the initial temperature of superheated liquid, and the time constant for the pressure rise, which was referred to as the relaxation time of nonequilibrium, was measured. The relaxation time tau exhibited a decreasing trend with the initial bulk temperature of liquid or the incipient boiling superheat. The evaporation coefficient C was evaluated from the experimental data of pressure and volume of vapor bubble on the basis of Hertz-Knudsen equation from kinetic theory.

34905 (NUREG/CP—0014(Vol.3), pp 1950-1966) **Gas- and vapour-bubble-detection in sodium-cooled fuel-elements.** Benkert, J.; Raes, K.H.; Reimche, W.; Stegemann, D. (Univ. of Hannover, Germany). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

An experimental program has been performed to investigate different detector types for measuring volumetric gasfractions and its distribution under identical two-phase-flow conditions. Chen-detectors, Jodel-detectors and permanent electromagnetic flowmeters were tested at the same time in different test sections by use of sodium-argon-mixtures over a wide range of flow velocities and volumetric gasfractions. The normalized mean voltage of the detector signals versus the known average volumetric gasfraction in the flow channel has been used to compare the different detector types.

34906 (NUREG/CP—0014(Vol.3), pp 1967-1978) **Thermal conductivity and viscosity of particle beds.** Schulz, B. (Kernforschungszentrum, Karlsruhe, Germany). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The paper shows the general possibility of treating particle bed debris with respect to their thermal conductivity and viscosity as quasihomogeneous materials. For the special case of fuel granulation in liquid metals during a part of the PAHR-phase in LMFBR-core meltdown, equations are presented.

34907 (NUREG/CP—0014(Vol.3), pp 2064-2095) **Application of the one-dimensional two-fluid model to transient two-phase flows.** Liu, W.S.; Nieman, R.E. (Atomic Energy of Cánada, Pinawa, Manitoba). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

In safety analyses associated with nuclear reactors, vapor-liquid flows produced by rapid depressurization due to discharge through a break of initially subcooled liquid flowing in a network of pipes is of particular interest. In this work, a set of working equations for transient one-dimensional two-phase flows which allow unequal phase velocities and temperatures are presented. Specific attention is focussed on the equations for separated and mixed flow structures. The relationships for interface and wall transfer processes, and the difference between the phase and interface pressures for these idealized flow structures are considered. The mathematical and physical behavior of the model is examined by studying propagation velocities of acoustic waves in various flow regimes. The model is applied to a simple benchmark problem to demonstrate its practicality. Interface heat transfer and virtual mass terms are shown to play significant roles in the predicted transients.

34908 (NUREG/CP—0014(Vol.3), pp 2112-2125) **Finite element solution of two-dimensional coupled energy and momentum equations with variable properties.** Chung, K.S. (Argonne National Lab., IL). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

This paper presents a finite element solution of steady-state, coupled energy and momentum equations with variable properties. The pressure and velocity approach of the finite element method with the Laplacian form of pressure equation was adopted in solving the problem. The emphasis of the present work is on the improved understanding of the thermal-hydraulic behavior in a Liquid Metal Fast Breeder Reactor, in particular, the natural circulation phenomenon. The result of the present work is utilized in investigating the mixed convection phenomenon as well as the forced convection phenomenon for the developing flow and the fully developed flow. In addition, a brief discussion is made as to how the turbulent viscosity and the turbulent thermal diffusivity can be evaluated for the buoyancy induced flow and flow with low Prandtl number.

34909 (NUREG/CP—0014(Vol.3), pp 2176-2188) **Thermal-flow performance of the Fort St. Vrain high temperature gas-cooled reactor core during two design-basis accidents.** Conklin, J.C. (Oak Ridge National Lab., TN). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The Fort St. Vrain 330 MW(e) HTGR was designed and built by General Atomic Company and is operated by Public Service Company of Colorado. FLODIS, an ORNL computer code written specifically to analyze the core thermal-flow response of this reactor, was used to investigate two postulated design basis accidents: the design basis depressurization accident (DBDA), and the loss of forced convection (LOFC) accident. FLODIS can calculate the distribution of flow among the 37 refueling regions and the internal flow distribution within the individual refueling regions.

34910 (NUREG/CP—0014(Vol.3), pp 2222-2252) **Natural circulation cooling potential of $CO_2$ and He for GCFR's.** Melese d'Hospital, G.B. (General Atomic Co., San Diego, CA). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

With acceptable elevation difference (about 10 m) between midcore and heat sink, natural circulation of fully pressurized helium can remove the afterheat from a typical GCFR at shutdown (about 6% of full power). But with natural circulation at low pressure the helium flow becomes laminar and is insufficient to remove any significant amount of afterheat, even with higher coolant and cladding temperature limits than during normal operation. As much as 1% afterheat fraction could be removed with 2 atmospheres (absolute) $CO_2$, while repressurization of the reactor to 12 atm of helium would be necessary to remove this afterheat with the same temperature conditions. Generalized curves valid for turbulent and laminar flow of $CO_2$ and helium show the variations of pressure ratio versus power ratio for natural circulation. For the same afterheat removal conditions, the required $CO_2$ pressure varies from 1/6 to 1/3 of the corresponding He pressure.

34911 (NUREG/CP—0014(Vol.3), pp 2352-2369) **Thermal hydraulics of the pebble bed high temperature reactor under accident conditions.** Peterson, K.; Verfondern, K.; Barthels, H.; Banaschek, J. (Nuclear Research Centre, Juelich, Germany). 1980. NTIS. Order Number DE81903586.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The transient temperature behavior of the pebble bed core after loss of forced cooling is determined by the natural heat transport phenomena heat conduction, convection and radiation. The 2-D-transient thermal hydraulics code THERMIX allows to quantify these effects for core heat up accidents with a pressurized and depressurized primary circuit and for the flow stability analysis for the lay-out of the auxiliary cooling system. The core internal natural convection heat transport is simulated by a convection experiment which is described by the code with high accuracy. The effective heat conductivity of the homogenized pebble bed at elevated temperatures has been gained by high temperature experiments.

**34912 (TRITA-HFL—0028) Sensitivity of the fracture probability in a reactor vessel to variations in data.** Nilsson, Fred; Palm, S. (Studsvik Energiteknik AB, Nykoeping (Sweden)). May 1980. 31p. (SKI-B—37-79). NTIS (US Sales Only), PC A03/MF A01.

The report discusses the sensitivity of the fracture probability of a reactor vessel. The main problem has been to find relevant input data to the statistical model. The model is based on the linear elastic fracture mechanics. The probability of fracture toughness, of non-detection and of the initial distribution of defects is taken into consideration. The loads and fatigue data are considered as deterministic. The probability of fracture for all welds was calculated to $P^0$sub (b tot) (T) = 8.34 x $10^{-8}$, where T is the service life of the vessel. The study discusses relative deviations when varying input data. The value of $P^0$ sub (b tot) is found to increase fast during the first four years and it remains constant afterwards. The sensitivity analysis shows that P sub (b tot) is very sensitive to input data for fracture toughness and for the distribution in initial defects. In the case of detectability the probability of fracture is inversely proportional to the probability of detection of cracks in the interval 10 to 15 mm.

**34913 NRC-industry cooperative effort sets stage for probabilistic risk assessment studies.** Mallay, J.F. *Nuclear News (La Grange Park, Illinois) ;* **24**: No. 11, 87-92(Sep 1981).

The US Nuclear Regulatory Commission has joined hands with key industry personnel to develop a procedures guide on methods of probabilistic risk assessment. In an unprecedented move, the NRC initiated discussions with industry representatives in mid-1980 on the feasibility of gaining broad technical input to its Interim Reliability Evaluation Program (IREP). The objective of the joint NRC-industry program is to prepare a procedures guide that documents the present state of the art for all major facets of probabilistic risk assessment (PRA) as applied to nuclear power plants. The guide will not constitute an encyclopedia of all possible approaches, but will focus on one or a few mutually acceptable methods of performing key portions of PRA.

**34914 (UCRL-Trans—11699) Measurement of natural oscillations of the suppression chamber of the GKSS pressure-suppression test stand.** Boettcher, G.; Kolb, M. (Lawrence Livermore National Lab., CA (USA)). Jul 1981. Translation of GKSS—81/E/19. 68p. NTIS, PC A04/MF A01. Order Number DE81030659.

In order to interpret the periodicities of the fluid pressure and of the wall strain and acceleration measured in pressure-suppression tests, a modal analysis was performed for the empty and partially filled suppression chamber. The chamber was struck repeatedly at one point via a load cell, and the resultant motions of the wall were recorded by means of continuously shifted acceleration transducers, so that the frequency characteristics of the compliance could first be determined for each measurement point and then the natural oscillation of the structure could be determined from that. Six global natural oscillations of the chamber could be identified. The three lowest frequencies (40, 52, 78 Hz) correspond approximately to those found in the pressure-suppression tests.

**34915 (UCRL-Trans—11705) Evaluation of infrared absorption measurements for blowdown tests in the pressure release system of the Marviken reactor.** Barschdorff, D.; Neumann, M.; Wioga, S. (Lawrence Livermore National Lab., CA (USA)). Jul 1981. Translation of KFK—2534, October 1977. 59p. NTIS, PC A04/MF A01. Order Number DE81030660.

After a short description of the instrumentation, the earlier published underlying theoretical model is further developed and the data evaluation is treated in detail. In particular, a new absorption quotient method for droplet size determination in an extended radius scope, the data evaluation, and the computation of the transient droplet velocity using correlation techniques are treated. As an example, for Blowdowns 18 and 20, the starting phase of a Blowdown, the mean droplet radius in the two-phase flow, and periodical mass flow fluctuations during certain phase of the Blowdown are analyzed.

**34916 Fire suppressing apparatus.** Buttrey, K.E. (to Dept. of Energy). US Patent Application 218,248. 19 Dec 1980. 7p.

Apparatus for smothering a liquid sodium fire comprises a pan, a perforated cover on the pan, and tubed depending from the cover and providing communication between the interior of the pan and the ambient atmosphere through the perforations in the cover. Liquid caught in the pan rises above the lower ends of the tubes and thus serves as a barrier which limits the amount of air entering the pan.

**34917 Fission product release from dynamically heated mixed oxide reactor fuels.** Benson, D.A.; Gorham-Bergeron, E. (Sandia Labs., Albuquerque, NM). Contract AC04-76-DP00789. *High Temperature Science ;* **13**: No. 1, 21-34(1980).

Knowledge of the fraction and rates of fission product release from molten oxide fuel that has been heated on a millisecond time scale are needed for thermal transient calculations in fast reactor safety analysis. Release of fission products in the vapor phase can produce pressurization leading to fuel motion in such safety studies. In the present work, experiments have been carried out to investigate such gas release behavior for thermal transients in the millisecond range. A series of experiments is described in which fuel samples are heated to temperatures in the 5000°K range in less than one millisecond by fission heating in the Sandia Pulsed Reactor. The oxide sample is contained by a pressure vessel inside of which a transducer monitors the pressure of vapor phase material over the fuel as a function of time. Oxide fuel in the form $(U_{0.75}, Pu_{0.25})O_2$ previously irradiated to a burnup of 5.3% and retaining approximately 30% of the fission gas was selected for the sample material. Analysis based upon an equilibrium chemical model of the oxide is used to determine upper bounds on the pressure generated in the vapor phase for comparison with experimental measurements. The pressures observed in these experiments for times in the millisecond range are lower than the equilibrium calculations. This owes at least partially to heat transfer and mass diffusion effects. 8 figures.

**34918 Steam explosions in the molten iron oxide/liquid water system.** Nelson, L.S. (Sandia National Labs., Albuquerque, NM). *High Temperature Science ;* **13**: No. 1, 235-256(1980).

Steam explosions have been produced by flooding molten iron oxide with liquid water in an arc melting apparatus. The explosions are caused by fine breakup of the melt and rapid transfer of enthalpy from the melt to the water. Explosions do not occur unless the melt-boiling water interfacial region is disturbed by application of a modest (~ 1 MPa high, 50 μs wide) pressure transient to the aqueous phase; similar pulses introduced directly into the melt have not initiated explosions. Explosions occur for compositions in the range of $1.10 < O/Fe < 1.27$. No measurable change in the iron-oxygen ratio occurs during the explosions, within the precision of the analytical methods used. Release of gas within the melt has been hypothesized as one possible cause of breakup of the hot liquid in a steam explosion. Although some qualitative evidence suggests that such gas release processes might occur, the analytical results and phase equilibrium relationships do not support such a mechanism for molten iron oxides. 9 figures, 4 tables.

**34919 Multidimensional analysis based on a two-fluid model of fluid flow in a component of the loft system during a loss of coolant experiment.** Demmie, P.N. (Edgerton, Germeshausen and Grier Inc, Idaho Falls, Idaho). pp 1417-1460 of Multiphase transport: fundamentals, reactor safety, applications (proceedings of the multi-phase flow and heat transfer symposium-workshop), 1979. Veziroglu, T.N. (ed.). Washington, DC; Hemisphere Publishing Corp. (1979).

From 2. multiphase flow and heat transfer symposium workshop; Miami Beach, FL, USA (16 Apr 1979).

A computer analysis of fluid flow in the Loss-of-Fluid Test (LOFT) cold leg blowdown pipe during a Loss-of-Coolant Experiment (LOCE) was performed using the computer program K-FIX/MOD1. The purpose of this analysis was to evaluate the capability of K-FIX/MOD1 to calculate theoretical fluid quantity distributions in the blowdown pipe during a LOCE for possible application to the analysis of LOFT experimental data. 9 refs.

# 25 ENERGY STORAGE

*REFER ALSO TO CITATION(S) 35100*

## 2501 Magnetic

*REFER ALSO TO CITATION(S) 35374*

## 2502 Compressed Gas

34920 **(DOE/ET/29232—T4-Vol.2) Compressed air energy storage: preliminary design and site development program in an aquifer. Volume II. Utility system planning. Final report.** (Public Service Co. of Indiana, Inc., Plainfield (USA)). 31 Jul 1981. Contract AC02-78ET29232. 112p. NTIS, PC A06/MF A01. Order Number DE82000466.

A study was performed to evaluate the performance of an aquifer compressed air energy storage system and a final report has been prepared describing the findings made in the study. Volume II of the final report represents the work performed by the five utility sponsors and provides an analysis of the benefits derived from the integration of a compressed air energy storage facility with a hypothetical electrical network. The analysis was based on three study scenarios each having a target generation mix of 65% base, 25% intermediate and 10% peaking capacity. Scenarios of 100% coal, 50% coal and 50% nuclear, and 100% nuclear base load capacity additions were examined. Final results of the analyses indicate favorable economics when compressed air energy storage is installed as an alternative to combustion turbine peaking capacity on a system with a significant amount of oil-fired generation.

34921 **(DOE/ET/29232—T4-Vol.5-Pt.2) Compressed air energy storage preliminary design and site development program in an aquifer. Final report, Volume V, Part II, Appendix F. Dynamic system computer model.** Berman, P.A.; Bonk, J.S.; Kobett, W.F.; Kosanovich, N.S.; Long, L.J.; Marinacci, D.J. (Public Service Co. of Indiana, Inc., Plainfield (USA); Westinghouse Electric Corp., Concordville, PA (USA). Combustion Turbine Systems Div.). 31 Jul 1981. Contract AC02-78ET29232. 489p. NTIS, PC A21/MF A01. Order Number DE82000671.

The Dynamic Computer Model, Appendix F, is contained in Volume V - Part II of the Turbomachinery Design Report (Part I contains the main body of the report). Appendix F documents the computer program and subroutines written to provide a general purpose modeling tool for a CAES power plant system. The CAES plant has been modeled using FORTRAN and a Control Data Corporation 7600 digital computer. The system model was developed to: learn the transient response characteristics of the complete CAES plant; provide a tool for evaluating the requirements and performance of control systems proposed for the CAES plant; provide a general purpose digital-computer-based dynamic modeling tool; and provide power plant component models as FORTRAN subroutines which can be used, with appropriate parameter data, as modules in complete CAES power plant models.

## 2505 Flywheels

34922 **(EPRI-EM—227) Investigation of multi-ring fiber-composite flywheels for energy storage. Final report.** Gordon, H.S. (Brobeck (William M.) and Associates, Berkeley, CA (USA)). Sep 1976. 142p. NTIS, PC A07/MF A01. Order Number DE82900082.

Test of fiber-glass composite flywheels and the dynamics of the pendular support system used are described. Results of tests on one and two concentric ring systems up to a surface speed of 1630 ft. per minute and energy density of 14.2 watt-hours per pound are reported. Designs and test results on various means of ring support from the hub and from adjacent rings are included.

## 2506 Thermal

34923 **(CONF-810940—4) Alternatives to ceramic bricks and ceramic-brick systems.** MacDonald, J.M. (TRW, Inc., McLean, VA (USA)). 1981. Contract W-7405-ENG-26. 10p. NTIS, PC A02/MF A01. Order Number DE81032029.

From Annual contractors' review meeting on thermal and chemical storage; Tysons Corner, VA, USA (16 Sep 1981).

Alternative materials for use as TES media in electric storage furnaces have been evaluated and selected. Selections were based on: low cost; availability; durability; and energy storage density. The materials selected were: taconite pellets; river gravel; crushed stone; and crushed (air-cooled) blast furnace slag. Essential material properties and energy storage densities were established. A conceptual design for an electric storage furnace using these low-cost materials has been developed. The performance of this conceptual furnace has been characterized by use of an analytical model. A computer code for the model has been developed. Existing performance data for present-day electric storage furnaces have been evaluated, and performance and design comparisons between present-day furnaces and the prototype furnace have been made. With the limited data at this time, a significant cost advantage for the proposed furnace, with equivalent performance, over existing electric storage furnaces cannot be established. Future work required for materials testing and component development has been identified.

34924 **(CONF-810940—6) Effect of additives on performance on hydrated-salt TES systems.** MacCracken, C.D. (Oak Ridge National Lab., TN (USA); Calmac Mfg. Corp., Englewood, NJ (USA)). 1981. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE81032032.

From Annual contractors' review meeting on thermal and chemical storage; Tysons Corner, VA, USA (16 Sep 1981).

Calmac's objectives under this contract will be to evaluate a gelling agent, developed by Calor, Ltd. of England, as a means of preventing stratification in sodium thiosulfate pentahydrate and Glauber salt eutectic phase change materials; to determine techniques for the field filling and to develop repair procedures for systems incorporating the Calor gel; to study the effects of ethylene glycol and glycerin on the thermal performance of sodium thiosulfate pentahydrate and Glauber salt eutectic PCM; and to evaluate the effect of pH modification of sodium thiosulfate pentahydrate, specifically with regard to subcooling behavior. Progress is reported.

34925 **(LA-UR—81-2513) Alternate thermochemical cycles.** Hollabaugh, C.M.; Bowman, M.G.; Peterson, C.L. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810940—5). NTIS, PC A02/MF A01. Order Number DE81030248.

From Annual contractors' review meeting on thermal and chemical storage; Tysons Corner, VA, USA (16 Sep 1981).

Experimental verification of all steps in the bismuth sulfate cycle has been obtained. At acid concentrations greater than 52.7 wt %, normal $Bi_2(SO_4)_3$ is formed but at lower concentrations, greater than 3.0 wt %, the bismuth oxysulfate, $Bi_2O(SO_4)_2$, is formed. Upon heating to temperatures in the range of 975 to 1150° K, both decompose by the loss of $SO_3$ to a final composition of $Bi_2O_{2.3}(SO_4)_{0.7}$. The higher sulfates are regenerated by reaction of this product with $H_2SO_4$. Solids handling and decomposition have been studied in a laboratory-scale rotary kiln and a dual-particle fluidized bed. Kiln experiments with $Bi_2O(SO_4)_2$, $ZnSO_4$, and $Co_3O_4$ have shown that in temperature range of 1125 to 1285°K, over 90% decomposition occurs during the 60 s residence time. A higher temperature is required for $La_2(SO_4)_3$ decomposition. A dual-particle fluidized bed was constructed and tested with $ZnSO_4$ powder. Even with the short residence time of less than 1.0 s, over 50% decomposition is obtained at a temperature greater than 1223° K. Cycles based on solids decomposition matches the thermal characteristics of an isothermal heat source in contrast to the $H_2SO_4$ cycle which best fits the heat delivery characteristics of a gas cooled reactor. A comparison has been made of the heat requirements for both $H_2SO_4$ and $Bi_2O(SO_4)_2$ decomposition and the results evaluated relative to the load line of a gas cooled reactor.

34926 **(LBL—11029) Study of ATES thermal behavior using a steady-flow model.** Doughty, C.; Hellstroem, G.; Fu Tsang, C.; Claesson, J. (Lawrence Berkeley Lab., CA (USA)). Jan 1981. Contract W-7405-ENG-48. 79p. NTIS, PC A05/MF A01. Order Number DE81030883.

The thermal behavior of a single well aquifer thermal energy storage system in which buoyancy flow is neglected is studied. A dimensionless formulation of the energy transport equations for the aquifer system is presented, and the key dimensionless parameters are discussed. A simple numerical model is used to generate graphs showing the thermal behavior of the system as a function of these parameters. Some comparisons with field experiments are given to illustrate the use of the dimensionless groups and graphs.

## 2509 Batteries

*REFER ALSO TO CITATION(S) 34522, 35114*

34927 **(ANL—81-38) Chemical Engineering Division annual technical report, 1980.** Burris, L.; Webster, D.S.; Barney, D.L.; Cafasso, F.A.; Steindler, M.J. (Argonne National Lab., IL (USA)). Jun 1981. Contract W-31-109-ENG-38. 228p. NTIS, PC A11/MF A01. Order Number DE81030216.

Highlights of the Chemical Engineering (CEN) Division's activities during 1980 are presented. In this period, CEN conducted research and development in the following areas: (1) rechargeable lithium-aluminum/iron sulfide batteries for electric vehicles and other applications; (2) ambient-temperature batteries - improved lead-acid, nickel/zinc, and nickel/iron - for electric vehicles; (3) energy-efficient industrial electrochemical processes; (4) molten carbonate fuel cells for use by electric utilities; (5) coal technology, mainly fluidized-bed combustion of coal in the presence of $SO_2$ sorbent of limestone; (6) heat- and seed-recovery technology for open-cycle magnetohydrodynamic systems; (7) solar energy collectors and thermal energy storage; (8) fast breeder reactor chemistry research - chemical support of reactor safety studies, chemistry of irradiated fuels, and sodium technology; (9) fuel cycle technology - management of nuclear wastes, reprocessing of nuclear fuels, and proof-of-breeding studies for the Light Water Breeder Reactor; and (10) magnetic fusion research - systems analysis and engineering experimentation, materials research, and neutron dosimetry and damage analysis. The CEN Division also has a basic energy sciences program, which includes experimental and theoretical research on (1) the catalytic hydrogenation of carbon monoxide and methanol homologation, (2) the thermodynamic properties of a wide variety of inorganic and organic materials, (3) significant mechanisms for the formation of atmospheric sulfate and nitrogen-bearing aerosols, (4) processes occurring at electrodes and in electrolytes, and (5) the physical properties of salt vapors. In addition, the Division operated the Central Analytical Chemistry Laboratory.

34928 **(DOE/CS/25204—01) Battery and electrochemical systems. Program summary.** (Mitre Corp., McLean, VA (USA); Department of the Air Force, Los Angeles, CA (USA)). Nov 1979. Contract AI01-79ET25204. 306p. NTIS, PC A14/MF A01. Order Number DE82000077.

The Electrochemical Storage Systems has divided its activities into seven functional areas. These are: (1) near-term batteries, (2) advanced batteries, (3) solar applications, (4) dispersed applications, (5) electrochemical systems, (6) supporting research, and (7) electrolytic technology. The near term program is dedicated to the creation of viable batteries for electric vehicles in the pre- and post-1985 periods. The advanced battery and electrochemical systems support longer term vehicle battery requirements and solar and dispersed applications. The solar and dispersed applications are each specifically targeted to provide batteries appropriate for the intended application. Electrochemical systems and supporting research provide the fundamental and applied research for support of the other programs. The Electrolytic Technology Program is targeted at developing energy efficient electrolytic and electrochemical industrial processes and is intended to directly conserve energy. This program summary provides short synopses of the objectives, pesent status, problem areas, and current accomplishments of each contractor and subcontractor supporting DOE in the area of electrochemical storage systems. (WHK)

34929 **(DOE/ET/25425—T1) Temperature limitations of alkaline-battery electrodes. Part 1. The electrochemical kinetic behavior of iron, nickel, and zinc in concentrated sodium hydroxide solutions. Final report.** McKubre, M.C.H.; Macdonald, D.D. (SRI International, Menlo Park, CA (USA)). Nov 1979. Contract AC01-78ET25425. 208p. NTIS, PC A11/MF A01. Order Number DE81027235.

The electrochemical kinetic properties of the metals iron, nickel, and zinc have been studied in concentrated electrolyte, in the temperature range -20° to 120°C. Three electrolyte concentrations have been examined for iron and nickel, corresponding to 20, 24, and 28 wt % NaOH. Zinc has been studied in detail only in the highest concentration. The principal tools and methods used in this study were single and repetitive sweep voltammetry, potential step and potential sweep coulometry, and the use of rotating ring disk electrodes. From a comprehensive survey of the dependence of cyclic voltammagrams on the potential sweep rate, we have been able to document the kinetic limitations imposed by Ni and Fe electrodes as a function of temperature. The major temperature limitations found are associated principally with irreversible electrode reactions; electrode dissolution (Fe and Zn), electrolysis (Fe and Ni), and irreversible components of film growth (Fe and Ni). In addition, Zn was found to undergo a temperature-dependent passivation process, which results in current oscillation under high load conditions.

34930 **(EPRI-EM—226) Development program for solid-electrolyte batteries. Final report.** Silverman, H.P.; Marcoux, L.S.; Seo, E.T. (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). Sep 1976. 101p. NTIS, PC A06/MF A01. Order Number DE82900246.

The sodium-sulfur battery uses molten sodium and sulfur as the active electrode materials, employs a solid electrolyte (beta alumina), and is operated 300 to 350°C. The system is particularly promising for utility application because of the intrinsically low materials costs. The TRW cell design differed from those employed in other domestic sodium-sulfur battery programs in that the solid electrolyte was planar rather than tubular. This approach was advantageous from the standpoint of cell component cost and battery system design. These advantages were unfortunately obtained at the expense of a more complicated cell seal. The study demonstrated that the major challenges of developing the sodium-sulfur battery into a commercially viable energy-storage system are: (1) development of corrosion resistant sulfur-electrode containers; (2) design and development of a less highly stressed seal; (3) fabrication of long-life electrolytes; and (4) design of cells capable of full utilization of the active positive-electrode material (sulfur). Results are reported.

34931 (LBL—11983, pp 3.39) **Applied battery and electrochemical research program.** Cairns, E.J.; McLarnon, F.R. Mar 1981. NTIS, PC A03/MF A01. Order Number DE81030532.

In Chemical process research and development program, FY 1980.

Lawrence Berkeley Laboratory (LBL) has lead mission responsibility for management of the Applied Battery and Electrochemical Research Program, which is supported by the Office of Advanced Conservation Technologies of the Department of Energy (DOE). This program provides the applied research base which supports all of DOE's Electrochemical Systems missions, and the general objective of the program is to help provide electrochemical systems that can satisfy economic, performance, and schedule requirements. The specific goal of the project is to identify the most promising electrochemical technologies and transfer them to industry and/or another DOE program for further development and scaling-up. Accomplishments and planned activities are outlined. (WHK)

34932 (LBL—11983, pp 3.40-3.41) **Battery electrode studies.** Cairns, E.J.; McLarnon, F.R.; Katz, M.; Nichols, J. Mar 1981. NTIS, PC A03/MF A01. Order Number DE81030532.

In Chemical process research and development program, FY 1980.

This project's purpose is to study the behavior of electrodes used in secondary batteries and to investigate practical means for improving their performance and lifetime. Systems of current interest include ambient-temperature rechargeable cells with zinc electrodes (Zn/NiOOH, Zn/AgO, Zn/$Cl_2$, Zn/$Br_2$, Zn/Air, and Zn/$Fe(CN)_6$) and rechargeable molten salt cells (Li-Al/FeS, Li-Al/$FeS_2$, Li-Si/FeS, Li-Si/$FeS_2$, and Na/$\beta$-$Al_2O_3$/NaCl-$AlCl_3$-$SCl_4$). The approach used in this investigation is to study the life- and performance-limiting phenomena under realistic cell operating conditions. Accomplishments and planned activities are outlined. (WHK)

34933 **(SAND—81-1955C) Compatibility and accelerated aging study for Li(Si)/$FeS_2$ thermally activated batteries.** Mead, J.W.; Searcy, J.Q.; Neiswander, P.A.; Poole, R.L. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 12p. (CONF-810953—1). NTIS, PC A02/MF A01. Order Number DE81030210.

From JOWOG-12 conference; Aldermaston, UK (21 Sep 1981).

These batteries are for use in systems which require a storage life of 25 years and high reliability. This compatibility and aging study incorporates all of the materials in the system, both organic and inorganic, except the heat paper and electric match. Resulss indicate no compatibility or aging problems. These results are: oxygen vanishes from the overgas in containers that were accelerated-aged; hydrogen increases sharply in the overgas initially but generally decreases as aging progresses. No unexpected or significant changes were observed in the volume resistivity, glass transition temperature, or shear modulus or organic materials. (DLC)

34934 **(SAND—81-7147C) Design and cost analysis of a 20-kWh bipolar zinc-bromine battery.** Einstein, H.; Bellows, R.J.; Grimes, P.; Kantner, E.; Malachesky, P.; Newby, K. (Exxon Research and Engineering Co., Linden, NJ (USA). Advanced Energy Systems Labs.). 1981. Contract AC04-76DP00789. 8p. (CONF-811010—4). NTIS, PC A02/MF A01. Order Number DE81030117.

From 6. electric vehicle council symposium; Baltimore, MD, USA (21 Oct 1981).

Zinc-Bromine secondary batteries are attractive systems for electric vehicles and energy storage (off-peak and photovoltaic) applications because of low cost raw materials, relatively high energy density, and ambient temperature operation. Exxon's approach to the system uses conductive carbon plastic electrodes in a bipolar configuration, separable bromine complexes, and selective membranes in a circulating electrolyte design. The 20 kWh battery design consists of two 10 kWh battery stacks placed back-to-back with a common center electrolyte feed block. Each of the two battery stacks consists of 78 cells for a system voltage of 120 volt output. Active electrode area per electrode is 12 $dm^2$. Cell-to-cell spacing is 0.25 cm. The two-stack module is assembled over a tray serving as a cover for the plastic electrolyte reservoir. Unit cells are comprised of alternating bipolar electrodes and separator assemblies. For various applications, accessories and controls are built into the system. The projected battery factory price of $28./kWh is discussed, along with the manufacturing, materials, and labor costs.

34935 **(UCRL—86648) Temperature and concentration transients in the aluminum-air battery.** Homsy, R.V. (Lawrence Livermore National Lab., CA (USA)). 26 Aug 1981. Contract W-7405-ENG-48. 22p. (CONF-811013—4). NTIS, PC A02/MF A01. Order Number DE81030338.

From Electrochemical Society conference; Denver, CO, USA (11 Oct 1981).

Coupled conservation equations of heat and mass transfer are solved, that predict temperature and concentration of the electrolyte of an aluminum-air battery system upon start-up and shutdown. Results of recent laboratory studies investigating the crystallization kinetics and solubility of the caustic-aluminate electrolyte system are used in the predictions. Temperature and concentration start-up transients are short, while during standby conditions, temperature increases to a maximum and decreases slowly.

34936 **Method for uniformly distributing carbon flakes in a positive electrode, the electrode made thereby and compositions.** Mrazek, F.C.; Smaga, J.A.; Battles, J.E. (to Dept. of Energy). US Patent Application 206,234. 19 Jan 1981. 17p.

A positive electrode for a secondary electrochemical cell is described wherein an electrically conductive current collector is in electrical contact with a particulate mixture of gray cast iron and an alkali metal sulfide and an electrolyte including alkali metal halides or alkaline earth metal halides. Also present may be a transition metal sulfide and graphite flakes from the conversion of gray cast iron to iron sulfide. Also disclosed is a method of distributing carbon flakes in a cell wherein there is formed an electrochemical cell of a positive electrode structure of the type described and a suitable electrolyte and a second electrode containing a material capable of alloying with alkali metal ions. The cell is connected to a source of electrical potential to electrochemically convert gray cast iron to an iron sulfide and uniformly to distribute carbon flakes formerly in the gray cast iron throughout the positive electrode while forming an alkali metal alloy in the negative electrode. Also disclosed are compositions useful in preparing positive electrodes.

34937 **Device for detecting the specific gravity of a liquid.** Derouin, C.R.; Kerwin, W.J.; McCormick, J.B.; Bobbett, R.E. (to Dept. of Energy). US Patent Application 208,100. 18 Nov 1980. 19p.

A device for detecting the specific gravity of a liquid and a device for detecting the state of charge of a liquid phase electrolyte battery are described. In one embodiment of the present invention, a change in the critical angle of total internal reflection is utilized to determine the index of refraction of the liquid to be measured. It is shown that the index of refraction of the liquid is a function of the specific gravity of the liquid. In applications for measuring the state of charge of a battery, the specific gravity is proportional to the state of charge of the battery. A change in intensity of rays intersecting an interface surface indicates the critical angle which is a direct indication of the specific gravity of the liquid and the state of charge of a battery. In another embodiment, a light beam is projected through a transparent medium and then through a portion of the liquid to be measured. A change in refraction due to a change in the index of refraction of the liquid produces a deflection of the beam which is measured by a detector. The magnitude of deflection of the beam is directly proportional to the specific gravity of the liquid and the state of charge of a battery.

# 29 ENERGY PLANNING AND POLICY

*REFER ALSO TO CITATION(S) 35100, 35108*

34938 **Proceedings of third annual energy seminar.** Erie, PA; Gannon University (1981). 215p. (CONF-810383—). $7.00.

From 3. annual energy seminar; Erie, PA, USA (31 Mar 1981).

Fifteen papers are included (three in the addendum). Separate abstracts were prepared for all the papers. (DLC)

## 2902 Economics And Sociology

*REFER ALSO TO CITATION(S) 34492, 34496, 34499, 34949, 34961, 34963, 34965, 34966, 34988, 35013, 35014, 35015, 35016, 35017, 35468, 35469, 35470*

34939 **(DOE/CS/30013—T2) Residential fuel costs for SOLCOST Data Bank cities, winter 1980.** Weir, S.B. (Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center). Mar 1981. Contract FG01-79CS30013. 105p. NTIS, PC A06/MF A01. Order Number DE82000470.

A listing of residential fuel costs for cities included in the SOLCOST Data Bank is compiled. Commodities considered include electricity, natural gas, No. 2 fuel oil and coal. The document shows for each city the 1970 population, the 30 year mean annual heating and cooling degree days based on 65°F, and the mean daily solar radiation in Btu-per-square-foot based on a global horizontal value. The company name for each commodity is shown with calculations for the cost of each commodity including all charges and

taxes. These include cost-per-ton of coal, cost-per-1000-kWh of electricity, cost-per-10,000-cubic-feet of natural gas and cost-per-gallon of No. 2 fuel oil. Calculations are then made for cost-per-million-Btu for each commodity. Weighted averages are calculated for each state, DOE Regional Solar Energy Center, and the United States. These averages are based only on the sites included in the report and are weighted by the populations of those cities. Cost data are drawn from the basic rate structures for each company. Appendix A contains a computerized ranking of the costs of each commodity from the highest cost to the lowest cost based on the calculations made in this document. Appendix B contains a selected bibliography. (MCW)

34940 **(DOE/CS/30013—T3) Rate guide for residential No. 2 heating oil and coal for SOLCOST Data Bank cities.** Christensen, D.L.; Weir, S.B. (Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center). Dec 1980. Contract FG01-79CS30013. 251p. NTIS, PC A12/MF A01. Order Number DE82000483.

A preliminary listing of residential No. 2 heating oil and coal prices for cities included in the SOLCOST Data Bank is presented. The list shows the name of one company chosen at random in each city. Rates of companies in the same city are relatively the same, therefore, only one company is represented. The name is shown so as not to misrepresent any other companies. The information shown represents the data as quoted by each company. This includes the basic rate, the taxes, and the delivery charge, if not included. The minimum represents the minimum amount sold to any one customer. Computations have been made to show cost per gallon of fuel oil, cost per ton of coal, cost for both commodities with taxes, and cost-per-million Btu. Taxes are calculated on the basic rate and does not add the delivery charge where it is not included. The Btu values used in converting to cost-per-million Btu are 136,000 Btu per gallon of fuel oil number two and 25,070 Btu for coal. These values will vary from city to city. (MCW)

34941 **(DOE/CS/30013—T4) Utility rate guide for SOLCOST Data Bank cities.** Christensen, D.L.; Weir, S.B. (Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center). May 1980. Contract FG01-79CS30013. 354p. NTIS, PC A16/MF A01. Order Number DE82000468.

A listing of residential utility rates for cities included in the SOLCOST Data Bank is presented. The format shows the residential rates for electricity and natural gas for each city and shows company name, customer and minimum charges, fuel adjustment, taxes, and surcharges. The date of currency is also shown. Rate structures for each company are shown as quoted by that company. Computations have been made for each step showing the total without charges and taxes, the total with charges and taxes, the cost per kWh or CCF, and the cost per million Btu with charges and taxes. Maps depicting costs per million Btu are included in Appendix A. These costs are averages of those cities researched and may not represent a true average of the entire state. The averages are shown without taxes. They are shown both for basic rates and rates adjusted for extra charges and fuel adjustments. Appendix B shows rankings by cost for each region. The map and cost rankings have been drawn from the regional documents. (MCW)

34942 **(DOE/ET/20154—T1) Methodology for the analysis of investment alternatives to stimulate development and technology transfer for energy technologies.** (TRW Energy Systems Planning Div., McLean, VA (USA)). Sep 1978. Contract AC05-78ET20154. 28p. NTIS, PC A03/MF A01. Order Number DE82000465.

This report presents a methodology for the analysis of incentives that could be offered by the government to encourage the development and commercialization of selected energy technologies. A decision-oriented approach has been adopted in characterizing a typical company's response to implementation of a particular government incentive. This approach is described in detail and applied to a case study of solar photovoltaics. The methodology is sufficiently general to be applied with minor modifications to other case studies. The methodology includes a computer model, INVEST, that calculates net present values and internal rates of return for prescribed investments in manufacturing facilities. (MCW)

34943 **(EPRI-EA—1961, pp 5.1-5.32) Optimal strategic pricing policies with learning.** Bass, F.M. (Purdue Univ., Lafayette, IN); Bultez, A.V. Aug 1981. NTIS, PC A15/MF A01. Order Number DE81904228.

From Workshop on the choice and utilization of energy-using durables; Boston, MA, USA (1 Nov 1979).

An investigation is made of the consequences of the learning effects on the pricing strategy followed by a monopolistic firm based on two simple, yet general premises: that the demand for the product is a time-varying function of the current price and some uncontrollable environmental variables and that the total cost of production depends on the accumulated experience and on the current output. Generalizations are explored of both the cost function and demand function. Through numerical methods, optimal, myopic, and constant pricing policies under special conditions are compared. (MCW)

34944 **(EPRI-EM—1506-Vol.3) Solar heating and cooling of buildings (SHACOB): requirements definition and impact analysis-II. Volume 3. Customer load management systems.** Cretcher, C.K.; Rountree, R.C. (Aerospace Corp., El Segundo, CA (USA). Energy and Resources Div.). Nov 1980. 87p. NTIS, PC A05/MF A01. Order Number DE82900208.

Customer Load Management Systems, using off-peak storage and control at the residences, are analyzed to determine their potential for capacity and energy savings by the electric utility. Both Conventional Load Management (CLM) and Direct Solar with Load Management (DSLM) systems are addressed for Electric Power Research Institute (EPRI) synthetic utility service areas broadly representative of utilities in the regions around Washington, DC and Albuquerque, NM. The performances of CLM and DSLM systems are investigated in terms of sensitivity to storage tank parameters and charging magnitudes/schedules. Near optimum tank volumes are determined for both service areas, and charging magnitude and charging duration/off-time are identified as having the greatest influence on tank performance. The influence of Customer Load Management Systems on utility backup is addressed through two separate investigations: (1) sectioning of service areas according to various charging schedules, and (2) forecasting of residential loads to minimize charging requirements. Each approach is shown to have potential capacity savings benefits. The impacts on utility operations and corresponding utility/customer economics are determined in terms of delta demands used to estimate the utilities' generating capacity differences between the CLM, DSLM, and electric resistive systems. Energy differences are also determined. These capacity and energy deltas are translated into changes in utility costs due to penetration of the CLM or DSLM systems into electric resistive markets in the snapshot years of 1990 and 2000.

34945 **(EPRI-WS—77-18) Workshop proceedings: capital investment decisions.** (Michigan State Univ., East Lansing (USA)). May 1978. 233p. (CONF-7711149—). NTIS, PC A11/MF A01. Order Number DE82900107.

From Workshop on capital investment decisions; East Lansing, MI, USA (14 Nov 1977).

The overall purposes of the workshop were to (a) assess the relavance of capital investment and supply response theory to current activities in the energy producing industry, (b) assess the relevance of managerial decision-making theories and concepts to current supply activities, (c) attempt to bring theory and practice into common perspective for use in energy supply analysis, and (d) help EPRI's supply program to develop its research agenda on the basis of (a), (b) and (c). The report is divided into four parts. Part I contains papers from industry representatives to provide a practical perspective. Part II is more academic and theoretical. The first four papers of this section deal with investment theories, some of which have been applied in the energy industry. The next six papers in the section deal with managerial and decision-making theories. Part III consists of papers presenting industry reactions to the more academic papers in Part II. The chapter in Part IV attempts to provide a greater understanding of the problems of and interactions between capital investments and decision-making in energy producing firms. This increased understanding should improve consequent supply estimates. This part also presents a plan for doing research on energy supply responses under changing economic and environmental conditions. The final chapter reflects the current status of

economic concepts vis-a-vis capital investment and decision-making which was considered in Part II.

34946 **Measurement of vertical integration.** Maddigan, R.J. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Review of Economics and Statistics ;* **63**: No. 3, 328-335(Aug 1981).

An index of vertical integration is constructed as a tool to examine how the average level of vertical integration has changed over time. The hypothesis that if vertical integration can lower costs or reduce risks, more firms will integrate vertically is subjected to an empirical test using the Vertical Industry Connection index. A random sample of firms is selected from the COMPUSAT data base. The results support the contention that vertical integration has increased in contrast with Laffer's findings. 17 references, 10 figures, 3 tables.

## 2903 Environment, Health, And Safety

*REFER ALSO TO CITATION(S) 34245, 34498, 34960, 35426, 35432, 35471, 35472, 35473, 35516, 35522, 35526, 35527, 35528*

## 2904 Natural Resources

*REFER ALSO TO CITATION(S) 34297, 34299, 34300*

## 2905 Research, Development, Demonstration, And Commercialization

*REFER ALSO TO CITATION(S) 34306, 34989*

34947 **(LBL—12615) Conference on energy research at historically black universities.** (Lawrence Berkeley Lab., CA (USA); Department of Energy, Washington, DC (USA)). 1980. Contract W-7405-ENG-48. 146p. (CONF-8006180—). NTIS, PC A07/MF A01. Order Number DE81030152.

From Conference on energy research at historically black universities; Williamsburg, VA, USA (17 Jun 1980).

A conference was convened to present and discuss significant research and development in Historically Black Institutions (current and past); areas that show potential for inter-institutional collaboration and the sharing of facilities; existing capabilities to sustain funded research activities and future potential for expansion and enhancement; and appropriate arrangements for maximum interaction with industry and government agencies. Papers were presented at small group meetings in various energy research areas, and abstracts of the projects or programs are presented. The Solar Energy small group provided contributions in the areas of photovoltaics, biomass, solar thermal, and wind. Research reported on by the Fossil Fuel small group comprises efforts in the areas of fluidized bed combustion of coal, coal liquefaction, and oil shale pyrolysis. Five research programs reported on by the Conservation Research small group involve a summer workshop for high school students on energy conservation; use of industrial waste heat for a greenhouse; solar energy and energy conservation research and demonstration; energy efficiency and management; and a conservation program targeted at developing a model for educating low income families. The Environment Impact groups (2) presented contributions on physical and chemical impacts and biological monitors and impacts. The Policy Research group presented four papers on a careful analysis of the Equity issues; one on a model for examining the economic issue in looking at the interaction between energy technology and the state of the economy; and a second paper examined the institutional constraints on environmental oriented energy policy. Six additional abstracts by invited participants are presented. (MCW)

## 2906 Nuclear Energy

*REFER ALSO TO CITATION(S) 34365, 34368, 34370, 34374, 34375, 34795, 34975, 35469, 35470, 35742*

34948 (CONF-810250—, pp 27-31) **Energy from heaven and earth.** Teller, E. (Stanford Univ., CA). Jul 1981. NTIS, PC A05/MF A01. Order Number DE81027613.

From WATTec energy awareness conference; Knoxville, TN, USA (19 Feb 1981).

Dr. Teller, of thermonuclear weapon fame, suggests two things the US can do to avert tragedy in the Persian Gulf: (1) increase domestic energy supplies, and (2) improve energy utilization. Energy production, he feels, will increase as a result of deregulation and pro-nuclear policies. He notes that an assessment of nuclear risks, which includes the harm caused by avoiding the risk as well as the risks from exposure, will show that nuclear energy is the safest and cleanest form of energy available. Steps need to be taken to break the deadlock at the Nuclear Regulatory Commission so that plant licensing can resume, he says. Further, he observes that improved uranium mining methods and reprocessing procedures, thorium substitution for uranium, and fission/fusion reactions are among the steps that should be considered. (DCK)

34949 **(PNL—3796) Comparative analysis of risk characteristics of nuclear waste repositories and other disposal facilities.** Lindell, M.K.; Earle, T.C.; Nealey, S.M. (Battelle Human Affairs Research Center, Seattle, WA (USA)). Jun 1981. Contract AC06-76RL01830. 109p. (B-HARC—411/81/005). NTIS, PC A06/MF A01. Order Number DE81030720.

Three fundamental questions concerning public perception of the measurement of radioactive wastes were addressed in this report. The first question centered on the perceived importance of nuclear waste management as a public issue: how important is nuclear waste management relative to other technological and scientific issues; do different segments of the public disagree on its importance; the second question concerned public attitudes toward a nuclear waste disposal facility: how great a risk to health and safety is a nuclear waste disposal facility relative to other industrial facilities; is there disagreement on its riskiness among various public groups; the third question pertained to the aspects of risks that affect overall risk perception: what are the qualitative aspects of a nuclear waste disposal facility that contribute to overall perceptions of risk; do different segments of the population associate different risk characteristics with hazardous facilities. The questions follow from one another: is the issue important; given the importance of the issue, is the facility designed to deal with it considered risky; given the riskiness of the facility, why is it considered risky. Also addressed in this report, and a main focus of its findings, were the patterns of differences among respondent groups on each of these questions.

## 2907 Transport And Storage

*REFER ALSO TO CITATION(S) 34972, 35115*

## 2908 Waste Heat Utilization

*REFER ALSO TO CITATION(S) 35355*

34950 **(ANL/FE—81-56) Assessment of the potential of coal-fueled heat engines in total and integrated energy systems.** Bratis, J.C.; Jain, M.L.; Marciniak, T.J. (Argonne National Lab., IL (USA)). Jun 1981. Contract W-31-109-ENG-38. 80p. NTIS, PC A05/MF A01. Order Number DE82000169.

The potential of several prime movers, especially those that use coal, is investigated for use in total and integrated energy systems in the residential and commercial sector. The prime movers considered are diesels, Stirlings, internally and externally fired gas turbines, and steam turbines. In contrast to the conventional system that uses electricity and sometimes natural gas, oil, or coal, a total energy system produces electricity, heating, and cooling to supply the needs of the community, be it a large building or a group of buildings. Total energy systems based on the prime movers listed above are compared to the conventional system for four communi-

ties that represent different ratios of residential-to-commercial area. These comparisons show the energy savings, environmental effects, and economic benefits. In general, total energy systems save energy but increase local air pollutant emissions because of increased fuel use. However, most of them will improve overall regional air quality if the comparable conventional system obtains electricity from a coal-burning utility. Economic benefits are measured by the return on investment that was calculated for two different scenarios of future energy prices. For both scenarios, neither coal- no oil-using total energy systems have a definite economic advantage.

34951 **(DOE/ET/10381—197) Industrial application of fluidized-bed combustion. Quarterly technical progress report, January-March 1981.** (Georgetown Univ., Washington, DC (USA)). 1981. Contract AC21-76ET10381. 123p. NTIS, PC A06/MF A01. Order Number DE81030272.

In line with a determination by the federal government that a fluidized bed combustion process can efficiently convert the energy of coal to usable power in an evironmentally acceptable manner, Georgetown University was awarded a contract to construct and operate a demonstration plant. This report reflects the progress made during the fifth full quarter of plant operation. The January through March 1981 period constituted the sixth full quarter of Task 4 Operations in which plant operations were essentially performed by the Georgetown University staff, with 2 contractor-supplied men on site to monitor and evaluate boiler operations and to assist the university staff in preventive and corrective maintenance procedures, evaluation of plant auxiliary systems equipment malfunctions, and to institute minor plant modifications. The boiler was operated for six different periods during the quarter for a total of 1041 h. Of the six shutdowns, three could have been averted by operator attentiveness, one resulted from rock buildup in the bed, one was due to over limits particulate emission due to leaking bags in the baghouse, and one was due to an external control circuit short which affected the Solids Removal Control Panel. Quarterly operations since startup are summarized. 90% of the quarter's operation was performed with both beds in operation. During much of this period, the AFBB plant was supplying all of the campus steam load. Boiler thermal efficiency remained low reportedly averaging only 61.4% for the quarter. Factors affecting efficiency are discussed. As the result of a boiler inspection the decision was reached to plan for a shutdown in the succeeding quarter during which all in-bed tubes would be replaced with new treated tubes.

34952 **Plugging cogenerators into the grid.** Wayne, M. *EPRI (Electric Power Research Institute) Journal ;* **6**: No. 6, 6-14(Jul 1981).

The ability to stretch fuel supplies and expand power generation capacity without costly delays has spurred renewed interest in industrial cogeneration. The technology for the dual production of electricity and process heat is well established, but integrating these diverse and dispersed sources of generation into utility grids raises a number of institutional, economic, and environmental issues. The Public Utility Regulatory Policies Act (PURPA), for example, appears to favor industry, yet many industrial managers fear new regulation and the ideal of getting into a new field, while utilities have concerns about reliability and maintenance as well as the economic losses of baseload customers and ownership. Other questions involve which fuels to use for cogeneration. Cogeneration, however, offers benefits for both industry and utilities, including the opportunity for cooperation.

## 2910 Conservation

*REFER ALSO TO CITATION(S) 34603, 34603, 34959, 34983, 34985, 35043, 35060, 35065, 35069, 35092, 35113*

34953 **(DOE/CE—0004-Vol.1) Schools and hospitals grant award listing (Cycle I).** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Office of State and Local Assistance Programs). Sep 1981. 206p. NTIS, PC A10/MF A01. Order Number DE82000101.

The National Energy Conservation Policy Act (NECPA) of 1978, Title III, authorized the US Department of Energy (DOE) to implement multisector energy conservation grant programs aimed at assisting public and private non-profit schools and hospitals, buildings owned by units of local government and public care institutions. As a part of the implementation of the Title III NECPA grant programs, DOE awards matching grants to eligible institutions for the conduct of technical assistance (TA) analyses and energy conservation measures (ECM). The TA is a detailed engineering study of a building that identifies energy conserving building modifications that require significant capital investment. The ECM is the actual implementation of these energy conserving building modifications. NECPA limits ECM grant awards to schools and hospitals only. Those TA and ECM grants awarded during Grant Program Cycle II are listed. It is arranged in alphabetical order by State. The list consists of the following elements: Congressional District (CD), Grant Number, Grantee Name, Grantee Address, Federal Funds (Federal contribution to the total grant in dollars), and Budget and reporting (B and R) Number.

34954 **(DOE/CS/21388—2) Federal employee energy awareness program guide.** (Weil (Warren) Associates, Inc., Washington, DC (USA)). Sep 1981. Contract AC08-80CS21388. 66p. NTIS, PC A04/MF A01. Order Number DE81030944.

The manual presents information to assist Federal energy coordinators in establishing facility employee energy awareness programs. The three phases of the employee awareness program presented are: the Planning Phase (to design a program tailored to the needs of a particular facility); the Introductory Phase (to create an awareness among employees of the critical need to conserve energy); and the Maintenance Phase (to sustain employee interest and involvement in conservation). Detailed information on the implementation of the program is presented. (MCW)

34955 **Energy management activities in the United States.** Greiner, P.C. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 105-111(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Measures implemented to date by the US to deal with energy conservation and energy management are discussed. Major provisions of the National Energy Conservation Policy Act are noted and policies in the National Energy Plan are examined. Conservation features in new buildings, being formulated with a set of proposed Energy Performance Standards, are discussed. Conservation efforts by the utilities discussed are load management; thermal energy storage experiments; and two-way communication systems. The National Energy Watch program created by Edison Electric Institute, is described. (MCW)

## 2920 Supply, Demand, And Forecasting

*REFER ALSO TO CITATION(S) 34944, 34962, 34986*

34956 **(DOE/EIA/11975—T1) QUSER user's guide.** Buck, M.D. (Fiorello, Shaw and Associates, McLean, VA (USA); Control Data Corp., Rockville, MD (USA)). Sep 1981. Contract AC01-80EI11975. 77p. NTIS, PC A05/MF A01. Order Number DE81030681.

QUSER is a FORTRAN program that functions as the controlling routines of the Midterm Energy Market Model (MEMM). In MEMM, a linear program (LP) is solved iteratively until QUSER determines that all convergence criteria have been met. After each iteration, QUSER is called to calculate new input prices and demands for the next iteration of the LP. For each of the product sectors, QUSER calculates the new price for the next iteration as the weighted average of the price QUSER calculated for input to the previous iteration and the marginal price from that LP solution. The new prices are then used to calculate new demands by evaluating the demand function using cross-elasticities for each of the product sectors. The LP solution is considered to be a converged solution when the prices and demands input to the last iteration and the prices and demands from the LP solution differ by less than two percent. QUSER's other main function is to model energy pricing regulations for natural gas and electricity. These policies are based on average prices while the LP solution gives marginal prices. Therefore, it is necessary to compute the average

price by modelling the specific regulatory policy and then the difference between the marginal price and the average price, called the wedge.

**34957 (MASEC-R—79-031) North central states energy situation: a MASEC overview.** Scott, M.G. (Mid-America Solar Energy Center, Minneapolis, MN (USA)). 1 Aug 1979. Contract AC01-78CS55237. 114p. NTIS, PC A06/MF A01. Order Number DE82000484.

Energy topics of interest to the 12 North Central States are discussed. This report provides an overview of the relative status of national and regional energy situations. The influence of various governmental policies on availability and distribution channels for conventional energy sources (for example, oil, natural gas, electricity, and coal) is traced. Numerous figures and tables outline existing and forecasted amounts of regional energy demands and supplies. Areas where energy shortages are likely to occur are also identified. The report focuses on major energy supplies and their availability for the various geographical areas of the region. The goal is to present the present and future energy picture and show where energy shortages could occur, and how to plan for these future energy related problems.

**34958 (PNL-SA—9062) Marginal production cost of electricity to 1990: forecasting based on recent cost trends for coal and nuclear units.** Harrer, B.J.; Nieves, L.A.; Patton, W.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 20 May 1981. Contract AC06-76RL01830. 25p. (CONF-810757—1). NTIS, PC A02/MF A01. Order Number DE81029632.

From 56. annual conference of the western economic association; San Francisco, CA, USA (3 Jul 1981).

Statistical relationships developed from recent historical data were used to estimate future busbar electricity costs based on the future production costs for electricity generated by typical coal and nuclear units. In contrast to many studies of coal and nuclear generating costs (Bergstrom and Brandfon, 1979 and Davis, 1980), this study utilizes actual cross sectional data to develop cost estimates, rather than developing cost estimates for a generic unit. The cost impacts of flue gas desulfurization (FGD) scrubbers in coal units and cooling towers in nuclear units were included, both of which have seen increasing use in recent years because of environmental regulations. In addition, a sensitivity analysis was performed to examine the impacts of changes in capacity factors, carrying charges and fuel prices on the relative costs of coal and nuclear generated electricity.

**34959 Energy and the practical American.** Watson, L.A. (Northwestern Rural Electric Cooperative, Cambridge Springs, PA). pp 143-151 of Proceedings of third annual energy seminar. Erie, PA; Gannon University (1981).

From 3. annual energy seminar; Erie, PA, USA (31 Mar 1981).

All energy alternatives for the practical American are discussed. Energy conservation measures practiced in Pennsylvania are briefly noted and then experiences with wood, wind, solar, geothermal, and use of off-peak power are described. It is concluded that the practical man must be involved in conservation and support the continued development of all energy resources. (MCW)

## 2930 Policy, Legislation, And Regulation

*REFER ALSO TO CITATION(S) 34500, 34948, 34955, 34978, 34981, 34982, 35463*

**34960 (BNL—51358) Expert judgments for policy analysis.** Morgan, M.G.; Henrion, M.; Morris, S.C. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems; Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Engineering and Public Policy). 1980. Contract AC02-76CH00016. 138p. NTIS, PC A07/MF A01. Order Number DE81030997.

This report summarizes the deliberations of a small invitational three-day workshop, which explored the current state of the art and identified research needs in eliciting and using subjective probabilistic expert judgments for policy analysis involving energy and environmental systems. Part 1 of this report discusses the growing importance of these techniques and outlines the structure and objectives of the workshop. Part 2 summarizes many of the workshop's most-important deliberations. Part 3 contains a preliminary description of some of the essential elements of a program of national research which should be mounted in this area in order to provide the theoretical and applied understanding necessary to support a widespread adoption of techniques that use subjective expert judgments, stated in probabilistic terms, by regulatory agencies that are concerned with energy and environmental systems.

**34961 (CONF-810250—) Energy in the '80s: a call for leadership.** (Oak Ridge National Lab., TN (USA)). Jul 1981. Contract W-7405-ENG-26. 79p. NTIS, PC A05/MF A01. Order Number DE81027613.

From WATTec energy awareness conference; Knoxville, TN, USA (19 Feb 1981).

The theme of this conference - Energy in the '80s: A Call for Leadership - was selected to focus attention on what was believed to be what America needs now - to get on with the tasks at hand. This proceedings of the Public Awareness Symposium, held on February 19, featured six speakers; the address of Senator Jackson at the banquet on February 20, which concluded the conference is also included; a separate abstract was prepared for each of these seven presentations. Also, the society-sponsored technical session papers are listed in Appendix A, and the Engineering/Communication scholarships are noted in Appendix B.

**34962** (CONF-810250—, pp 7-11) **Time perspective in energy policy.** Schmitt, H.H. (US Senate, State of New Mexico). Jul 1981. NTIS, PC A05/MF A01. Order Number DE81027613.

From WATTec energy awareness conference; Knoxville, TN, USA (19 Feb 1981).

Senator Schmitt notes that bitter lessons from the past that regulation, taxation, and demagoguery lead to unstable energy supplies remain unlearned, but the new administration offers a chance to stimulate America's productive capacity and ingenuity. He thinks that encouragement of the oil and gas industry could provide enough low-cost energy for the transition to alternative fuels. He feels that a coherent program to develop solar and fusion fuels and new portable fuels will require dissolving DOE and reestablishing an independent ERDA. Further, Senator Schmitt advocates: (1) formation of a nuclear power administration from portions of DOE and the Nuclear Regulatory Commission; (2) federal partnership in funding and long-term research to see that new energy sources are environmentally sound; and (3) energy-efficiency encouragement through tax incentives and technological advancement. (DCK)

**34963** (CONF-810250—, pp 15-18) **Social impact of energy policy.** Wilson, M.B. (NAACP, Washington, DC). Jul 1981. NTIS, PC A05/MF A01. Order Number DE81027613.

From WATTec energy awareness conference; Knoxville, TN, USA (19 Feb 1981).

Ms. Wilson opines that the relationship between energy policy and the civil-rights movement is fraught with the potential for policies to restrict economic growth and to reduce job opportunities for minorities. Blacks and women remain uneasy about the President's economic proposals because minorities make up a disproportionate share of the unstable secondary labor market. Their concerns focus on the impact of replacing regulation with market mechanisms, the loss of affirmative action, and the shift to the private sector where minorities have made the least progress. Energy policies that remove social-policy initiatives will make it more difficult to widen the pool of productive workers. (DCK)

**34964** (CONF-810250—, pp 19-25) **Life: a risky business (but consider the alternatives).** Silber, J.R. (Boston Univ., MA). Jul 1981. NTIS, PC A05/MF A01. Order Number DE81027613.

From WATTec energy awareness conference; Knoxville, TN, USA (19 Feb 1981).

Dr. Silber notes that reality avoidance, fashionable in the US today, is reflected in government policies and individual behavior in every sector. He feels that energy-conservation efforts beyond improving efficiency are unrealistic because conservation requires a

voluntary reduction in living standard. Further, the public's view of the energy debate is distorted by business and media presentations, by the idea that risk can be eliminated, and by the no-fault principle that life can be lived without responsibility. Dr. Silber suggests that the energy companies and energy-equipment companies take the offensive in refuting the statements of those who advocate unrealistic energy futures. He observes that companies which live and operate in the real world are best able to educate the American people, and that they have an obligation to do so. (DCK)

34965 (CONF-810250—, pp 39-44) **1980s: a decisive decade.** King, L. Jul 1981. NTIS, PC A05/MF A01. Order Number DE81027613.

From WATTec energy awareness conference; Knoxville, TN, USA (19 Feb 1981).

Mr. King notes that liberal arts graduates with little understanding of science, engineering, or business tend to become journalists who must inform their readers and listeners about technical matters. Also, the media reflect social opinions and attitudes, and their changes parallel those of society. He further observes that the breakdown in public confidence in institutions during the 1970s included a disenchantment with both the press and technology. This was simultaneous with the energy crisis and served to increase US vulnerability. Mr. King says the current media message is one of shortage and, if accepted, could lead us to lose our expectations, our expertise, and, finally, our jobs and freedom because we gave up a technological future. (DCK)

34966 (DOE/ER/10044—T1, pp 46p, Attachment N) **News media coverage of selected energy policy proposals.** Sahr, R.C.; Gladstone, T. 15 Jul 1981. NTIS, PC A15/MF A01. Order Number DE81025882.

In Progress report to the Department of Energy in support of basic energy and policy research.

This paper reports the initial results of a study on news media coverage of selected energy policy proposals. Variation in coverage among news sources and between television news and national news magazines is examined. Three sets of energy proposals were chosen for analysis: energy policy proposals of April, 1977; phase out of oil price controls (April, 1979); and proposals for the development of synthetic fuels and other production aspects related to energy (July, 1979). Evaluations were made in terms of depth of coverage and in terms of slant. (DMC)

34967 **(ORNL—5784) Building a consensus about energy technologies.** Wilbanks, T.J. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 15p. NTIS, PC A02/MF A01. Order Number DE82000501.

Our difficulty in the United States in making and sustaining major energy policy decisions is considered. After reviewing this decision-making problem, this report outlines the major policy alternatives for making energy decision making more effective. To bound the territory, the focus is on relatively large decisions about energy technologies, but many of the ideas are applicable to other kinds of energy decisions as well. In general, the policy alternatives can be characterized as being either focused on technology or on social action. Technology-focused options include technology choices and improvements. Social action-focused options include information, incentives, legitimacy, and institutional changes. These options are so diverse and so complexly related to each other that it is hard to assess the individual contribution of any one of them. But it is clear that they pose several basic philosophical questions, such as whether to base decisions on strong central leadership or on broad consensus formation. And it is clear that the options vary in being best suited for business-as-usual situations or emergency decision-making situations.

34968 **(PNL—3788) Comparison of the incentives used to stimulate energy production in Japan, France, West Germany, and the United States.** Cole, R.J.; Sommers, P.; Eschbach, C.; Sheppard, W.J.; Lenerz, D.E.; Huelshoff, M.; Marcus, A.A. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1981. Contract AC06-76RL01830. 129p. NTIS, PC A07/MF A01. Order Number DE82000959.

This volume represents the culmination of a five-year research effort examining the incentives used to stimulate energy production in four countries, and the incentives used to stimulate energy consumption in one country. Following the theoretical approach developed for studying US energy incentives, the researchers in each country classified incentives into the following six categories: (1) Taxation, including exemption from or reduction of existing taxes; (2) Disbursements, in which the national government distributes money without requiring anything in return; (3) Requirements, including demands made by the government, backed by civil or criminal sanctions; (4) Traditional Services, including those almost always provided exclusively by a governmental entity; (5) Nontraditional Services, including those sometimes performed by non-governmental entities, as well as governmental entities (e.g., research and development); and (6) Market Activities, including government involvement in the market under conditions similar to those faced by non-governmental producers or consumers. A complete list of research reports prepared in the Federal Incentives series is provided in the Appendix.

34969 **Can the national energy acts of 1978 survive.** Cantieri, W.F. pp 1-13 of Proceedings of third annual energy seminar. Erie, PA; Gannon University (1981).

From 3. annual energy seminar; Erie, PA, USA (31 Mar 1981).

The five Acts of the 1978 Energy Acts, funding allocations for various programs in each Act, and some predictions on how the new administration will implement the programs are discussed. (MC)

34970 **Regulatory implications for energy for the decade of the 1980s: the Administration's energy initiatives and beyond.** Coleman, L.R. (Dept. of Energy, Washington, DC). *Natural Resources Lawyer ;* **13**: No. 4, 661-668(1981).

From Section of natural resources law, American Bar Association annual meeting; Honolulu, Hawaii, USA (5 Aug 1980).

The country has put together a bipartisan energy policy in the last few years that has had some favorable results. Imports and consumption of petroleum products are down and drilling activity is up. The public has responded to higher prices with conservation efforts, many of which receive government assistance. Energy prices have also helped to move synthetic fuels forward. Another area that will affect future energy supplies is Alaska natural gas and the policy developments with Canada, Mexico, and others. A major need that should be addressed is the inability of large consuming companies to coordinate their response in the world market. The need for producing countries to produce less than we want to buy and the situation of the Soviet Union will make this a difficult decade. the case is made for reactivating the Energy Mobilization Board to help shift the country to coal and nuclear fuels during this period. (DCK)

## 2940 Fossil Fuels

*REFER ALSO TO CITATION(S) 34213, 34245, 34276, 34297, 34298, 34299, 34300, 34303, 34305, 34306, 34693, 34973, 34987*

34971 (CONF-810250—, pp 47-50) **Geopolitics of oil.** Jackson, H.M. (US Senate, State of Washington). Jul 1981. NTIS, PC A05/MF A01. Order Number DE81027613.

From WATTec energy awareness conference; Knoxville, TN, USA (19 Feb 1981).

Senator Jackson, speaking at the banquet concluding the conference, observed that the most-important energy problem facing the US is related to the facts that our modern economy is built upon oil, that we will continue to depend on imported oil for the next 20 years, and that oil is a political as well as a market commodity. Besides economic and social impacts, global competition for oil supplies has implications for national security and world peace. A Congressional study of the geopolitics of oil found indications of a serious supply disruption in the 1980s. It also learned that the oil-producing countries want political as well as economic compensation, and that the consuming countries are willing to pay both prices. Senator Jackson feels that the myth of energy independence is a symptom that the US needs to revise its energy policy to account for these findings. Four key measures are suggested: (1) public and private stockpiling of petroleum, (2) allied planning to mitigate the effects of interruptions, (3) allied resistance to Soviet

advances in the Middle East, and (4) support for non-OPEC oil production. (DCK)

34972 **(DOE/EIA/10754—T7) Review of FRS and complementary pipeline data, economic analysis.** (Synergy, Inc., Washington, DC (USA)). 5 Oct 1981. Contract AC01-81EI10754. 209p. NTIS, PC A10/MF A01. Order Number DE82000750.

Operating information for gas pipeline companies for the year 1979 is presented. Ownership data are disclosed; balance sheets are provided; an economic analysis of the industry is included. (DMC)

## 2950 Hydrogen And Synthetic Fuels

*REFER ALSO TO CITATION(S) 34498*

34973 **(BNL—29962) Systems analysis of $H_2$/natural gas supplementation and separation.** Beller, M.; D'Acierno, J. (Associated Universities, Inc., Washington, DC (USA); Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). 1981. Contract AC02-76CH00016. 5p. (CONF-810940—3). NTIS, PC A02/MF A01. Order Number DE81030031.

From Annual contractors' review meeting on thermal and chemical storage; Tysons Corner, VA, USA (16 Sep 1981).

A systems analysis of the concept of supplementing natural gas with hydrogen was conducted in terms of present fuel supplies and prices. An added option was analyzed; this involves separation of the hydrogen from the mixed stream for use as a nonenergy commodity. The study concludes that no insurmountable barriers exist for the supplementation concept; the separation option will depend only upon economic factors.

34974 **Synfuels and the energy transition.** Balzhiser, R.E. *EPRI (Electric Power Research Institute) Journal ;* **6**: No. 6, 21-27(Jul 1981).

Adapted from a speed delivered at the 49th annual convention of the Edison Electric Institute.

The growth of synfuels capacity will be slow; and these fuels will complement, not replace, other sources of energy. The real transition, which is still just beginning in the US, is from natural fluid fuels to solid fuels and to renewable energy sources. Electrification, which can encompass both nuclear and renewable resources as well as centralized and dispersed technologies, is the key to this transition. Increased scarcity and expense of oil and gas accelerates the shift to electricity. The time has come to scale up oil-shale technology to commercial size so we can evaluate its technology, economics, and potential impact on the environment. Analysis indicates that integrated gasification - combined-cycle power plants are also ready for commercialization. Major capital commitments from industry are needed to supplement the government-funded Synthetic Fuels Corporation.

## 2960 Electric Power

*REFER ALSO TO CITATION(S) 34486, 34487, 34939, 34941, 34958, 35055*

34975 (CONF-810250—, pp 33-38) **Corporate view of the energy situation.** McDonough, M.J. (Westinghouse Electric Corp., Pittsburgh, PA). Jul 1981. NTIS, PC A05/MF A01. Order Number DE81027613.

From WATTec energy awareness conference; Knoxville, TN, USA (19 Feb 1981).

Mr. McDonough observes that the energy crisis in the US is a crisis of the imagination and the belief that prosperity is a normal situation. Further, electricity is still viewed as if the Golden Age of cheap energy continues and electric utilities must be treated with suspicion and financial restraint. While utility deregulation is not the answer, Mr. McDonough says electric utilities must become financially healthy because electricity is versatile, it can compete with oil and gas, and expansion of the industry can help to free the US from the Middle East. Nuclear power plant construction and the breeder program must overcome public apprehension, he feels. Finally, there are endless ideas for the use of electricity that require only imagination and confidence, he notes. (DCK)

34976 **(EPRI-P—1950-SR) EPRI Regional Systems. Special report.** Mulvaney, J.J. (Electric Power Research Inst., Palo Alto, CA (USA)). Jul 1981. 132p. NTIS, PC A07/MF A01. Order Number DE81904247.

The EPRI Regional Systems include generation supply and system load data representing the characteristics of six regions of the US as currently projected for 1990. These systems supersede the generation and load information in the Synthetic Utility Systems report (EM 285). The new systems provide updated information, as well as the ability to perform regional R and D analysis. They provide operating information only for existing generation capacity as of 1990, thus establishing the initial systems from which expansion scenarios can be developed. The EPRI Technical Assessment Guide should be used as a companion document for capital cost and operating data for future technologies after 1990. The EPRI Regional Systems have been developed by EPRI personnel for the assessment of R and D benefits by the EPRI staff and its contractors.

34977 **(EPRI-RP—1485-2) Fostering the transfer of energy analysis research.** Wagner, H.M. (Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1980. 32p. NTIS, PC A03/MF A01. Order Number DE82900086.

A survey of a number of individuals at utilities, industry associations, EPRI contractors and EPRI staff was conducted to solicit opinions on the transfer of Energy Analysis Department research. The survey findings led to a number of recommendations for immediate priorities and longer-term opportunities.

34978 **(MASEC-PA—81-069) Guide to the Public Utility Regulatory Policies Act (PURPA): implementing PURPA in Mid-America.** Englund, L. (Mid-American Solar Energy Complex, Minneapolis, MN (USA)). Jul 1981. Contract AC02-79CS30150. 70p. NTIS, PC A04/MF A01. Order Number DE81030865.

The law and regulations governing the sale of electricity to utilities are discussed. Information on financing a particular project and some analytical and negotiating skills is covered. The booklet is concerned with Sections 201 and 210 of the Public Utility Regulatory Policies Act and the rules promulgated by FERC in support of these sections. The current status of PURPA implementaton in each of the twelve states in the Mid-American region is discussed. Section II discusses Qualifying Facilities (QFs), eligibility criteria, and the rights and responsibilities of QF owners, while Section III is concerned with electric utilities, and Section IV deals with issues that QF owners need to know about. The Appendix features a state-by-state breakdown of PURPA's status, other pertinent information, and state contacts. (MCW)

34979 **(NP—1904144) Review of power planning in the Pacific Northwest: calendar year 1980.** (Pacific Northwest River Basins Commission, Vancouver, WA (USA)). Apr 1981. 141p. Pacific Northwest River Basins Commission, Vancouver, WA. Order Number DE81904144.

Many of the activities that occurred in the electric power industry in the Pacific Northwest during calendar year 1980 are reviewed in this publication. These include: significant power planning related events, activities, and studies; passage of the Pacific Northwest Electric Power Planning and Conservation Act on December 5, 1980, the Act becoming P.L. 95-501; the development of alternative and renewable energy resources; home weatherization programs; processing of preliminary permits for development of small hydro; investigation of geothermal resources; and nuclear power development setbacks as voters in the states of Montana, Oregon, and Washington passed initiatives regarding storage of nuclear waste and siting of nuclear powerplants. Information is included on: utility load estimates through the year 2020; the resources existing, under construction, and feasible for development in meeting the forecast loads; a large number of small hydro projects which are in various stages of the study and/or licensing process; and a comparison of loads and resources giving the overall picture of the power situation in the Pacific Northwest. It is concluded that deficits in firm energy occur in all of the next 10 years, under critical hydro conditions. Small hydro, wind, and biomass generation, along with an aggressive mandatory energy conservation program could eliminate the deficit. However, the assured

cost-effective potential realizable from these resources is unknown. Finally, the activities of the Power Planning Committee during the year are discussed, with a list of Committee publications included. A map titled Electric Power Plants in the Pacific Northwest and Adjacent Areas is included.

**34980 (ORNL/TM—7905) User's manual for RATEPAC: a digital-computer program for revenue requirements and rate-impact analysis.** Fuller, L.C. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 60p. NTIS, PC A04/MF A01. Order Number DE82000439.

The RATEPAC computer program is designed to model the financial aspects of an electric power plant or other investment requiring capital outlays and having annual operating expenses. The program produces incremental pro forma financial statements showing how an investment will affect the overall financial statements of a business entity. The code accepts parameters required to determine capital investment and expense as a function of time and sums these to determine minimum revenue requirements (cost of service). The code also calculates present worth of revenue requirements and required return on rate base. This user's manual includes a general description of the code as well as the instructions for input data preparation. A complete example case is appended.

**34981 (DOE/RG—0034/2Rev.7/81-Vol.1) Public Utility Regulatory Policies Act of 1978. Annual report to Congress.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). May 1981. 30p. NTIS, PC A03/MF A01. Order Number DE82000305.

This second annual PURPA report provides the first comprehensive picture of the relative progress state regulatory authorities and nonregulated utilities have made in fulfilling their obligations under PURPA. The first PURPA report, submitted to Congress and the President on May 9, 1980, while providing a useful overview, covered only the first eight months of the consideration process. This report, on the other hand, covers a much longer period (20 months) and indicates the rate of progress under PURPA in the course of the last year. Finally, although the period covered by this report ends on June 30, 1980, it indicates that state regulatory authorities and nonregulated utilities most likely have met the November 9, 1980, deadline for acting on the regulatory policy standards. This report is divided into two volumes. The first volume provides a general overview and summary of DOE's analysis. The following are reported in this volume: progress made by state regulatory authorities and nonregulated utilities in considering and adopting the PURPA standards; the requirements of the PURPA consideration and determination process, and reports on the extent of conformance by state regulatory authorities and nonregulated utilities with these requirements; characteristics of those standards adopted by state regulatory authorities and non-regulated utilities, or mandated by state law, in comparison to the substantive provisions of the standards specified in PURPA; and the activities of the Department in 1980 to assist state regulatory authorities and nonregulated utilities in carrying out their responsibilities under Titles I and III of PURPA and, thereby, further the three purposes of PURPA and related national energy goals.

**34982 (DOE/RG—0034/2Rev.7/81-Vol.2) Public Utility Regulatory Policies Act of 1978. Annual report to Congress.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). May 1981. 457p. NTIS, PC A20/MF A01. Order Number DE82000306.

The purposes of the report are to: summarize and analyze the reports submitted by state regulatory authorities and nonregulated utilities regarding their consideration, determinations on, and other actions related to the six rate-making and five regulatory policy standards established by PURPA; and describe federal actions conducted by DOE to assist the state regulatory authorities and nonregulated utilities in carrying out their responsiblities under Titles I and III of PURPA. The objective of this volume is to supplement the information provided in Volume I. This volume consists of a state-specific examination of the progress made by state regulatory authorities and nonregulated utilities in considering the PURPA standards and a detailed description of DOE's activities in furthering the purposes of PURPA. Additional information, including a set of detailed statistical exhibits for each of the 11 PURPA standards, is provided in a series of appendixes. An overview of PURPA and its requirements are presented and the reporting form used to analyze the progress of state regulatory authorities and nonregulated utilities is described.

## 2980 Consumption And Utilization

*REFER ALSO TO CITATION(S) 34979, 35015, 35017, 35018, 35060, 35061, 35062, 35063, 35064, 35066, 35067, 35068, 35070, 35071, 35072, 35075, 35076, 35077, 35078, 35079, 35081, 35091*

**34983 (EPRI-EA—1961) Choice and utilization of energy-using durables.** (Arizona Univ., Tucson (USA). Engineering Experiment Station). Aug 1981. 349p. (CONF-7911154—). NTIS, PC A15/MF A01. Order Number DE81904228.

From Workshop on the choice and utilization of energy-using durables; Boston, MA, USA (1 Nov 1979).

Separate abstracts were prepared for the nine included papers which deal with assessing the adequacy of state-of-the-art methods to analyze the choice and utilization of energy-using durables (e.g., major appliances and automobiles) by households.

**34984 (PNL—3558) Analysis of federal incentives used to stimulate energy consumption.** Cole, R.J.; Cone, B.W.; Emery, J.C.; Huelshoff, M.; Lenerz, D.E.; Marcus, A.; Morris, F.A.; Sheppard, W.J.; Sommers, P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1981. Contract AC06-76RL01830. 266p. NTIS, PC A12/MF A01. Order Number DE81031928.

The purpose of the analysis is to identify and quantify Federal incentives that have increased the consumption of coal, oil, natural gas, and electricity. The introductory chapter is intended as a device for presenting the policy questions about the incentives that can be used to stimulate desired levels of energy development. In the theoretical chapter federal incentives were identified for the consumption of energy as Federal government actions whose major intent or result is to stimulate energy consumption. The stimulus comes through changing values of variables included in energy demand functions, thereby inducing energy consumers to move along the function in the direction of greater quantity of energy demanded, or through inducing a shift of the function to a position where more energy will be demanded at a given price. The demand variables fall into one of six categories: price of the energy form, price of complements, price of substitutes, preferences, income, and technology. The government can provide such incentives using six different policy instruments: taxation, disbursements, requirements, nontraditional services, traditional services, and market activity. The four major energy forms were examined. Six energy-consuming sectors were examined: residential, commercial, industrial, agricultural, transportation, and public. Two types of analyses of incentive actions are presented in this volume. The generic chapter focused on actions taken in 1978 across all energy forms. The subsequent chapters traced the patterns of incentive actions, energy form by energy form, from the beginning of the 20th century, to the present. The summary chapter includes the results of the previous chapters presented by energy form, incentive type, and user group. Finally, the implications of these results for solar policy are presented in the last chapter. (MCW)

## 2990 Unconventional Sources And Power Generation

*REFER ALSO TO CITATION(S) 34418, 34433, 34435, 34469, 34470, 34471, 34472, 34473, 34474, 34475, 34476, 34477, 34482, 34485, 34488, 34501, 34503, 34516, 34524, 34525, 34535, 34536, 34567, 34601, 34604, 34609, 34638, 34639, 34647, 34648, 34649, 34650, 34651, 34652, 34653, 34654, 34666, 34979, 35096, 35097, 35098, 35432, 35468*

**34985 (BNL—51373) Strategic analysis of conservation and solar energy policies.** Goettle, R.J. IV; Groncki, P.J.; Hudson, E.A. (Brookhaven National Lab., Upton, NY (USA)). Jun 1980. Contract AC02-76CH00016. 27p. NTIS, PC A03/MF A01. Order Number DE82000252.

A wide range of specific policy measures concerned with increasing the technical efficiencies of energy use and promoting the use and competitiveness of various solar, renewable resource, and

conservation technologies are examined. The focus is on the socio-economic impacts of two policy packages - the Basic and the Enhanced. The packages are examined for their economic, distributional, energy, and environmental effects. The introduction of the Basic package of conservation and solar programs is estimated to have favorable impacts on all major socioeconomic criteria - energy imports and energy use, real incomes and productivity, inflation, distribution, and environment. Intensifying the policy measures beyond those in the Basic package, or at least intensifying them in the direction defined by the Enhanced package, creates additional energy and economic benefits but the economic improvements cannot match the costs imposed by the new policies.

34986 (CONF-801030—(Vol.2), pp 801-806) **Size of alcohol fuel participation in the energy future of Brazil.** Wright, J.T.C. (Universidade de Sao Paulo, Brazil). 1980. (In Portuguese). NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

34987 **(DOE/S—00012) New and renewable energy in the United States of America.** (Solar Energy Research Inst., Golden, CO (USA)). Jun 1981. Contract AC02-77CH00178. 115p. NTIS, PC A06/MF A01. Order Number DE81030887.

The United States national paper for the 1981 United Nations conference.

This report is a contribution of the United States of America to preparations for the 1981 United Nations Conference on New and Renewable Sources of Energy. It describes the current technical and economic status of technologies and US experience with and expectations for new and renewable energy sources in the United States. It also outlines the roles of the public and private sectors in developing and using these energy sources. Specific technologies discussed are: low, intermediate, and high temperature solar collectors; biomass, wind, and ocean energy systems; hydropower; geothermal systems; oil shale; and tar sands. A short bibliography and suggestions for obtaining additional information are included. A glossary and a list of acronyms relating to the special terms used by developers and users of the technologies are also included. (MCW)

34988 **(MEDDELELSE—37) Regional analysis of potential energy production from agricultural wastes: a technical and economic study.** Have, H. (Kongelige Veterinaer- og Landbohoejskole, Copenhagen (Denmark). Jordbrugsteknisk Inst.). Sep 1979. 162p. NTIS (US Sales Only), PC A08/MF A01.

The possibilities for utilization of agricultural wastes for energy production are analyzed in two Danish counties, Ringkoebing and Vestsjaelland, which have different agricultural production patterns. The quantitative analysis shows that the major waste products, surplus straw, waste wood and animal waste, in total with present technique can cover about 28% of the demand for heat energy (mostly space heating) in both counties. The potential coverage from straw, wood and animal waste is about 3, 3 and 22% in Ringkoebing and 18, 2 and 8% in Vestsjaelland, respectively. A technical analysis indicates that direct combustion in the most favorable conversion method for straw and wood while biological conversion at present is best suited for animal waste. An economic analysis based on costs of collection, storage, transport and conversion of wastes and costs of corresponding oil and oil conversion were made. From a community point of view only straw and wood are found to be competitive to the expensive gas fuel oil when burned in automatically stoked furnaces. From a heating station point of view waste utilization is more attractive because of the sales tax on oil products. Here straw and wood are competitive fuels to both gas and heavy fuel oil in all the analyzed systems except from the small manually stoked furnaces. Animal waste seems to be competitive only when replacing gas fuel oil in medium size (500 kW) well utilized aerobic ferementeres. Apart from being economically attractive in many cases waste utilization for energy production also has positive effects on foreign payment balance, employment and supply safety. In addition it has advantages in reducing fire hazard by field burning of straw, sulphur pollution, odor emission and parasite infection from animal waste.

34989 **(NP—1904260) Renewable energy research in India.** (Tata Energy Research Inst., Bombay (India)). Aug 1981. 274p. Tata Energy Research Inst., Bombay, India. Order Number DE81904260.

A compenduim of progress reports received from 70 Indian organizations in the field of renewable energy research are presented. The areas of interest include: biogas, ethanol fuels; solar stills; solar driers; animal powered vehicles; mathematical modeling of energy systems; solar energy development; agricultural tools; biomass plantations; wind energy; engine development; photovoltaics; and energy conservation. (DMC)

34990 **(ORAU—185) Biomass energy systems: descriptions and employment requirements for typical operations.** Bell, S.E.; Little, J.R. (Oak Ridge Associated Universities, Inc., TN (USA)). Sep 1981. Contract AC05-76OR00033. 90p. NTIS, PC A05/MF A01. Order Number DE82000236.

On-site observations made on a wide variety of operations related to biomass energy combined with existing reports, feasibility studies, and expert opinion serve as the basis for the typical facility descriptions and employment estimates given in this report. While biomass energy facilities may be small by comparison to other energy sector operations, they can have sizable impacts on the communities and regions in which they are located. The employment and earnings generated during construction, operation, and maintenance can provide an important stimulus to local economies. The facility descriptions along with estimated employment and earnings implications given in this report provide a first approximation of what might be expected as the use of biomass energy systems increases.

34991 **DOE's role in the solar-energy industry, and possible anticompetitive trends. Hearing of the Committee on the Judiciary, United States Senate, Ninety-Sixth Congress, Second Session, November 14, 1980.** Washington, DC; Government Printing Office (1981). 108p.

Two panels of small businessmen and public-interest representatives testified on the competitive structure and the future of the solar industry. The witnesses, who also included a representative of DOE, discussed participation, decentralization, and innovation that it provides. A trend toward domination by major corporations, especially the oil companies, is developing because small companies are forced to sell for lack of capital. The implications of this trend for free enterprise and the possible stifling of innovation were explored by the witnesses. Eight prepared statements and two additional submissions follow the written testimony. (DCK)

# 30 DIRECT ENERGY CONVERSION

*REFER ALSO TO CITATION(S) 34927*

## 3001 Mhd Generators

*REFER ALSO TO CITATION(S) 35234*

34992 **(ANL/MHD—81-11) Simple code for chemical equilibrium and thermodynamic properties for use with GPSAP.** Geyer, H.K. (Argonne National Lab., IL (USA)). Jul 1981. Contract W-31-109-ENG-38. 28p. NTIS, PC A03/MF A01.

A simple code for chemical equilibrium and thermodynamic properties calculations is described. The code, designed to enhance the General Purpose Systems Analysis Preprocessor (GPSAP) system code for performing system studies where many different gas streams may occur, is based on the law of mass action and conservation of element mass. Fifteen gas species are considered, with the equations representing chemical equilibrium, solved by a Broyden update technique.

34993 **(DOE/ET/10785—T1) Testing and evaluation of MHD materials and substructures. Final technical report, April 1976-June 1981.** (Mississippi State Univ., Mississippi State (USA). MHD Energy Center). Jun 1981. Contract AC01-76ET10785. 204p. (FE—2246-15). NTIS, PC A10/MF A01. Order Number DE81024331.

Mississippi State University's MHD research group has constructed a Test Stand that can simulate the environment in any of the various substructures of a coal-fired baseline MHD power plant. After construction was completed, shakedown tests were performed, and the Test Stand was used in a series of tests to simulate the gas-stream composition and temperature conditions in the baseline plant's radiant boiler. The tests were conducted in order to study the effect of stoichiometry and staged combustion on the generation of nitrogen oxide. A computer-based monitoring and control system has been developed that provides safe Test Stand operation, controls the critical parameters, and accurately measures, displays, and logs the necessary physical data. Several computer programs have been developed to determine the thermal performance of the Test Stand, and several models have been developed to predict the thermal performance of the Test Stand with bare walls and with slag-coated walls, and to determine the gas stream properties as a function of temperature and pressure. A radiant boiler test section has been designed to enable corrosion tests to be performed on radiant boiler tube materials at the necessary gas-side and water-side temperatures. A gas sampling and analysis system and a ring sample corrosion probe have been constructed and are available for use with the Test Stand. Diagnostic instrumentation is being developed to characterize the gas-slag-seed stream. Remote operation of the two packaged, microprocessor-controlled systems - a line-reversal pyrometer system and a two-color pyrometer system - were successfully conducted on the Test Stand. Work is continuing on the development of a laser Doppler velocimeter system and a laser transmissiometer system.

34994 **(DOE/ET/10815—55) Two-dimensional effects in power take-off region.** Ishikawa, M.; Wu, Y.C.L. (Tennessee Univ., Tullahoma (USA). Space Inst.). May 1981. Contract AC02-79ET10815. 29p. NTIS, PC A03/MF A01. Order Number DE82000091.

A two-dimensional analytical model of the power take-off (PTO) region of a diagonal conducting wall (DCW) MHD generator is presented and compared with experimental results. Reasonable agreement was found in both voltage and current distributions from the two-dimensional analysis, while similar comparison of experimental data with one-dimensional calculations with experiments was not satisfactory. Power take-off from mid-channel was also investigated. It was found that larger current was carried by these electrodes. In addition, large circulating current was found in the sidewalls resulting from diagonalization. Therefore ballast resistors are required to equalize the current. A general PTO resistor design was proposed. Trade-off considerations between power output and protection of over-current were made.

34995 **(DOE/NASA/10769—10) High B-field, large-area-ratio MHD duct experiments.** Smith, J.M.; Wang, S.Y.; Morgan, J.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1981. Contract AI01-77ET10769. 13p. (NASA-TM—82673; CONF-810527—8). NTIS, PC A02/MF A01. Order Number DE81030664.

From International conference on plasma science; Sante Fe, NM, USA (18 May 1981).

Studies of the effect of area ratio variation on the performance of a supersonic Hall MHD duct have been extended up to area ratios of 6.25/1. It is shown that for a given area ratio there is a combustion pressure above which the power generating region of the duct is shock free and the power output increases linearly with the square of the magnetic field. Below this pressure a shock forms in the duct which moves upstream with increasing magnetic field strength and results in a less rapid rise in power output. 10 figures.

34996 **(EPRI—233) Design of 50-MWt closed MHD blowdown experiment. Parts I, II, and III. Final report.** Zauderer, B.; Marston, C.; Cook, C.; DeDominicus, D. (General Electric Co., Philadelphia, PA (USA). Space Div.). Sep 1975. 286p. NTIS, PC A13/MF A01. Order Number DE82900017.

The major components of an experimental facility for short duration, steady-state (blowdown) testing of a closed cycle, non-equilibrium MHD generator have been designed. The facility is rated at 50 MW (thermal) and will deliver 48 Kg/sec cesium seeded argon for approximately 1 minute. Stagnation conditions are 2000K, 10 atmospheres. Hot wall operation in the blowdown mode is achieved by preheating the ceramic lined part of the flow system to approximately 1200 K with electrically heated argon. The MHD channel will be supersonic ($1 < M < 2$), 3 meters long with an 18 cm x 25 cm entrance and a 6 to 1 area expansion. It is expected to produce 25% enthalpy extraction at 70% isentropic efficiency. The channel design features separately supported but overlapping ceramic blocks and is suitable for full scale power plant construction. Most of the ceramics are 80% dense alumina except for the innermost layer of the MHD channel and sersonic diffuser. Here thermal stresses inherent in the blowdown mode of operation led to the use of reaction bonded silicon nitride. The heat source will be an alumina, cored brick, ceramic, regenerative heat exchanger capable of being heated in 24 hours using either propane or low Btu coal gas fuel. The magnet is to be a cryogenically cooled (but not superconducting) design in saddle configuration employing hollow copper windings. It will produce a maximum field of 4.2 T at the channel

34997 **Superconducting magnet for Stanford University.** Parmer, J.F.; Magnuson, G.D.; Jones, R.G.; Taylor, W.D.; Peck, S.D.; Waszczak, J.P.; Williams, J.E.C.; Bobrov, E.S. (Gen Dyn, USA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-17**: No. 1, 344-347(Jan 1981). (CONF-800980—).

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

The thermal, electrical, and substructural aspects of an MHD superconducting magnet having a highly conductive substructure are discussed. The metallic substructure is beneficial for dissipation of stored energy during quench and for the restraint of conductor motion. A conductor quench and propagation analysis has demonstrated the utility of insulating wraps for the purpose of preventing inhibition of conductor normal zone growth. It is reported that the Department of energy is currently developing three MHD magnet concepts for application to baseload coal power generation technology. One of these concept is the Stanford Superconducting Magnet (SSM), a circular saddle magnet having a metallic substructure to support the conductors. It will be a part of the MHD research facility at Stanford University. 5 refs.

34998 **Apparatus for electrode current control in linear MHD generators.** Demirjian, A.M.; Solbes, A. (to Dept. of Energy). US Patent Application 217,355. 17 Dec 1980. 16p.

Apparatus is described for controlling a plurality of opposing, electrode, direct-currents at pre-set locations across a channel that comprises a converter for converting each electrode current into first and second periodic control signals which are 180° out of phase with respect to each other and which have equal magnitudes corresponding to the magnitude of the associated electrode current; and couplers for magnetically coupling individual ones of the first control signals and for magnetically coupling individual ones of the second signals such that the corresponding electrode currents are equalized or rendered proportional by balancing the same in the same or constant ratios in accordance with the locations of the electrode currents.

34999 **Regenerative air heater.** Hasselquist, P.B.; Baldner, R. (to Dept. of Energy). US Patent Application 210,486. 26 Nov 1980. 14p.

A gas-cooled steel skirt is used to support a refractory cored brick matrix and dome structure in a high temperature regenerative air heater useful in magnetohydrodynamic power generation. The steel skirt thermally expands to accommodate the thermal expansion of the dome structure despite substantial temperature differential thereby reducing relative movement between the dome bricks. Gas cooling of the steel skirt allows the structure to operate above its normal temperature during clean-out cycles and also allows for the control of the thermal expansion of the steel skirt.

35000 **On formation of a homogeneous two-phase foam flow.** Fabris, G.; Chow, J.C.F.; Dunn, P.F. (Argonne Natl Lab, Ill). *Journal of Engineering for Power ;* **102**: No. 4, 820-826(Oct 1980).

This paper presents the results of a series of experiments conducted to evluate the fluid mechanical performance of various

two-phase LMMHD (liquid-metal magnetohydrodynamics) mixer designs. The results from both flow visualization studies of the local two-phase flows downstream from various mixer-element configurations and local measurements performed to characterize these flows are presented. A conceptual LMMHD mixer design is described that insures the generation of small bubbles, prevents the formation of gas slugs and separated regions, and favors the stabilization of a homogeneous foam flow.

35001 **Refractory oxides for high temperature MHD heaters.** Smyth, R.R. (FluiDyne Engineering Corp., Minneapolis, MN); Pollina, R.J. *High Temperature Science ;* **13**: No. 1, 189-217(1980).

In a coal-burning MHD (magnetohydrodynamic) power plant, the use of a regenerative air heater is one option for producing the required high plasma temperatures. However, the thermal, mechanical, and chemical stresses that the MHD environment places on materials are enormous and candidate materials must be carefully tested. The results of such testing for a variety of materials studied in heater test facilities at both FluiDyne Engineering Corporation and at Montana State University are reported. The experimental program and test facilities for MHD heater development, the rationale for the choice of materials, and their performance (success or failure) under various environments are described. Results are analyzed and future materials needs are discussed in light of the observed effects.

## 3003 Thermoelectric Generators

35002 **(DOE/ET/33062—T3) Thermoelectric generator testing and RTG degradation mechanisms evaluation. Progress report No. 37.** Lockwood, A.; Shields, V. (Jet Propulsion Lab., Pasadena, CA (USA)). Sep 1980. Contract AI03-79ET33062. 60p. NTIS, PC A04/MF A01. Order Number DE81024237.

The n-type selenide legs after 16,500 hours continue to show reasonable agreement with the 3M Co. published thermal conductivity data. In the ingradient testing after 17,000 hours the 3 surviving n-legs (out of 5) show serious degradation in power to load. Small scale ratcheting has been observed on the four p-legs but no large scale effects. Weight loss for both coated and uncoated material produced by G.E. are reported. No significant discrepancies with the results previously obtained on R.C.A. material from the MHW program have been found. Thermal conductivity measurements are also in agreement. The remaining MHW generator on test, Q1-A, has accumulated 25,600 hours and performance remains stable. The 18 couple modules S/N-1 and -3 previously tested at RCA show no significant change in operation during the current JPL testing. No changes in the trends of degradation of LES 8 and 9 and the Voyager RTGs have been observed.

35003 **(DOE/ET/33062—T4) Thermoelectric generator testing and RTG degradation mechanisms evaluation. Progress report No. 36.** Lockwood, A.; Shields, V. (Jet Propulsion Lab., Pasadena, CA (USA)). Jul 1980. Contract AI03-79ET33062. 51p. NTIS, PC A04/MF A01. Order Number DE81024236.

The n-type selenide legs after 15,000 hours continue to show reasonable agreement with the 3M Co. published thermal conductivity data. In the ingradient testing after 16,500 hours the 3 surviving n-legs (out of 5) show serious degradation in power to load. Weight loss and thermoelectricity property measurements on the first samples of material produced by G.E. continue to correspond to the results previously obtained on R.C.A. material from the MHW program. The remaining MHW generator on test, Q1-A, has accumulated 23,679 hours and performance remains stable. The 18 couple modules S/N-1 and -3 previously tested at RCA show no significant change in operation during the current JPL testing. A comparison of LES 8/9 RTG's with an improved version of DEGRA is shown. No changes in the trends of degradation of LES 8 and 9 and the Voyager RTGs have been observed.

## 3005 Fuel Cells

*REFER ALSO TO CITATION(S) 35110, 35111*

35004 **(DOE/ET/11320—T6) High-temperature fuel cell research and development. Final technical status report, June 1977-September 1978.** Rasmussen, J.J.; Guidotti, R.; Lessing, P. (Montana Energy and MHD Research and Development Inst., Inc., Butte (USA)). 15 Oct 1978. Contract AC02-77ET11320. 218p. NTIS, PC A10/MF A01. Order Number DE81023095.

An initial survey of the literature produced a list of ceramic materials (other than lithium aluminate) with properties which made them potential candidates for use in molten-carbonate fuel cell tiles or electrodes. Seven of the materials in the original list were dropped from consideration because of unfavorable thermodynamic properties; four materials were set aside because of high cost, lack of availability, or fabrication difficulties. Thirteen compositions were tested statically at 1000 K in a $Li_2CO_3$-$K_2CO_3$ bath under a dry $CO_2$ atmosphere. Only four of the materials tested showed severe degradation reactions in the molten carbonate. A low-temperature process for forming small diameter, high-aspect ratio ceramic fibers for fuel cell use has been developed. A short-term program to initiate a computer study on the thermodynamic analysis of fuel cell materials was initiated at Montana State University. The MHD and high-temperature fuel cell literature was surveyed, and material properties were evaluated to identify MHD materials with potential use for fuel cell applications. A technology transfer report of these findings was prepared. Laboratory facilities were established to conduct research on interfacial diffusion processes which could be detrimental to successful long-term operation of the solid-electrolyte fuel cell. A variety of physical and chemical techniques were examined for the preparation of high-density substituted $LaCrO_3$ which was to be one component of a diffusion coupled with $Y_2O_3$-stabilized $ZrO_2$. Hydrolysis of a mixed metal-nitrate solution with urea produced the most reactive powder. A final theoretical density of almost 98% was attained in cold-pressed sintered discs of this material.

35005 **(DOE/ET/15440—3) Development of molten carbonate fuel cell power plant technology. Quarterly technical progress report No. 3, April 1, 1980-June 30, 1980.** (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). Mar 1981. Contract AC02-79ET15440. 90p. NTIS, PC A05/MF A01. Order Number DE81028387.

This report summarizes the work performed under US Department of Energy contract DE-AC01-79ET15440 during the third quarterly reporting period from April 1, 1980 through June 30, 1980. The overall objective of this 29-month program is to develop and verify the design of a prototype molten carbonate fuel cell stack which meets the requirements of 1990's competitive coal-fired electrical utility central station or industrial cogeneration power plants. The system studies task has completed definition of the economic requirements for a central station molten carbonate power plant as a function of regional location in the United States. Energy cost savings have been determined for an industrial cogeneration molten carbonate power plant. Subsystem options have been characterized for both central station and cogeneration applications. Preliminary design of the prototype stack continued based on a 9-ft$^2$ cell size and selection of candidate designs for long-lead-time stack hardware is underway. A laboratory test of a candidate electrical insulator showed satisfactory dielectric resistance at three times the anticipated full-scale stack voltage. A test plan was prepared for the first subscale stack. The design of the four-bay addition to the pressurized single cell test stand was completed and procurement of stand hardware is in process. Surveys of available data on impurities from a real gasifier system and from ambient air indicate the most likely to be harmful to molten carbonate fuel cells have been previously identified and are being studied in the appropriate tasks in this program. Design of the Mobile Test Facility has been completed. Testing of subscale cells under a variety of $H_2S$ levels has indicated that the water-gas-shift reaction is being poisoned. Theoretical analysis of the molten carbonate cell was expanded to include the effects of $H_2S$ in the fuel inlet gas.

35006 **(DOE/NASA/12726—10) Design and assembly considerations for Redox cells and stacks.** Stalnaker, D.K.; Lieberman, A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Sep 1981. Contract AI04-80AL12726. 12p. NTIS, PC A02/MF A01. Order Number DE82000415.

Individual Redox flow cells are arranged electrically in series and hydraulically in parallel to form a single assembly called a stack. The hardware currently being tested in the laboratory has an active electrode area of either 310 $cm^2$ (0.33 $ft^2$) or 929 $cm^2$ (1 $ft^2$). Four 310 $cm^2$ (0.33 $ft^2$) stacks, each consisting of 39 active cells, have been incorporated into a 1.0 kW preprototype system. The physical design of the stack is very critical to the performance and efficiency of the Redox storage system. The mechanical aspects of the cell and stack design for the current Redox hardware, with regard to sealing the stack internally as well as externally, minimizing shunt currents and minimizing the electrical resistance of the stack are described.

35007 **(FCR—1592) Improvement of fuel cell technology base. Progress report No. 7, 1 April-30 June 1979.** (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). 1979. Contract AC03-76ET11301. 23p. NTIS, PC A02/MF A01. Order Number DE81029542.

The effort is devoted to improving fuel cell power section technology from the 4.8-MW Demonstrator baseline and providing technology and design support for the 40-kW power plant development program. Significant accomplishments were made and are discussed. Cell 8095, the long term cell represent the Demonstrator configuration has reached 23,920 hours of endurance. Testing of the first 2.2-$ft^2$ 24-cell stack was completed after 2673 hours. Performance of GSA-6 cells was within 2 mV/cell of the performance goal despite accelerated decay testing and five times the anticipated shutdown rate. The second 3.7-$ft^2$ 20-cell stack completed 3128 hours of testing of which 2263 hours were spent at 93 psia, 405°F. The third 3.7-$ft^2$ 20-cell stack was assembled and has run for 450 hours. Performance is above goal and edge seal leakage is extremely low, well below an acceptable level. The long term subscale cell with a GSB-1 cathode has accumulated 8556 hours. Efforts to incorporate the improved edge seal into the substrate on the continuous process machine continued. Subscale testing to investigate freeze losses continued.

35008 **Evaluation of $TiO_2$-glass composites as interconnector material for solid-oxide-electrolyte fuel cells.** Russell, P.G.; Isaacs, H.S.; Tseung, A.C.C.; Srinivasan, S. (Brookhaven National Lab., Upton, NY). *Journal of Applied Electrochemistry ;* **11**: No. 2, 197-203(Mar 1981).

Electronically conducting interconnector materials are required to connect consecutive anodes and cathodes in high-temperature solid oxide fuel cells. Nb-doped $TiO_2$-glass composites, prepared by cold pressing and sintering in air above 1200°C, possess adequate conductivity and resistance to oxidizing and reducing atmospheres, as well as compatibility with $Y_2O_3$-doped $ZrO_2$. They thus show promise as interconnector materials.

35009 **(BNL—51429) Fuel-cell applied research: electrocatalysis and materials. Quarterly report, October 1, 1980-December 31, 1980.** O'Grady, W.E.; McBreen, J.; Isaacs, H.S.; Olender, H.; Hughes, J. (Brookhaven National Lab., Upton, NY (USA)). [nd]. Contract AC02-76CH00016. 12p. NTIS, PC A02/MF A01. Order Number DE82000173.

In this program, work is being carried out on four tasks: (1) effects of temperature and phosphoric acid concentration on oxygen reduction kinetics; (2) oxygen reduction kinetics in alternate acid electrolytes; (3) electrochemical surface science studies; and (4) organic oxidation reactions. Progress is summarized. (WHK)

# 32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

*REFER ALSO TO CITATION(S) 34603*

## 3201 Buildings

*REFER ALSO TO CITATION(S) 34566, 34940, 34944, 34953, 35426*

35010 **(CONF-810909—6) Development of a high-efficiency gas-fired water heater.** Vasilakis, A.D.; Gerstmann, J.; Pearson, J.F.; Walukas D.J. (Oak Ridge National Lab., TN (USA); TTI Corp., Needham Heights, MA (USA); Advanced Mechanical Technology, Inc., Newton, MA (USA); Foster-Miller Associates, Inc., Oak Ridge, TN (USA)). 1981. Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01. Order Number DE81032028.

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

This paper describes the design and development of a novel high-efficiency gas-fired residential water heater. Unlike conventional water heaters which use a center-flue water storage tank, this design decouples the water heating and storage functions through the use of an external heat exchanger, thus reducing standby losses. The compact high-effectiveness heat exchanger achieves a recovery efficiency of 82%, using a naturally-aspirated, 100% premixed burner. Besides its low cost, this burner has the additional advantage of producing very low emissions of NO/sub x/. The use of an internally insulated polyethylene lined 40-gallon storage tank is expected to provide significantly longer service life than conventionally-lined steel tanks, thereby enhancing consumer acceptance. The paper includes a description of the design of the water heater and the results of prototype efficiency and emission tests. Also included are data on heat exchanger and storage tank temperature distributions, standby losses, and hot water delivery capability.

35011 **(CONF-810909—7) Gas-heat-pump development.** Creswick, F.A. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01. Order Number DE81031991.

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

Incentives for the development of gas heat pumps are discussed. Technical progress made on several promising technologies is reviewed. The status of development of gas-engine-driven heat pumps, the absorption cycle for the near- and long-term gas heat pump systems, the Stirling engine, the small Rankine-cycle engines, and gas-turbine-driven heat pump systems is briefly reviewed. Progress in the US, Japan, and Europe is noted. (MCW)

35012 **(DOE/CE—0022) Daylighting.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC). Sep 1981. 12p. NTIS, PC A02/MF A01. Order Number DE82000930.

A catalog focusing on daylighting design and calculation methods in commercial buildings is presented. Primary sources of daylight in buildings are described briefly. Problems of appropriate design to maximize the use of daylighting; lighting controls; and operable sun control devices are discussed. (MCW)

35013 (EPRI-EA—1961, pp 1.1-1.26) **Structured logit model of appliance investment and fuel choice.** Goett, A.A. (Cambridge Systematics, Inc., Berkeley, CA). Aug 1981. NTIS, PC A15/MF A01. Order Number DE81904228.

From Workshop on the choice and utilization of energy-using durables; Boston, MA, USA (1 Nov 1979).

Household decisions to install space heaters, water heaters, and air conditioning systems in new construction are examined. The study adopts a discrete choice approach to modelling appliance purchase patterns in which the consumer's decision is characterized as choosing a single element from a limited set of generic appliance alternatives. The econometric specification - the structured or nested logit - has been shown to be consistent with a model of random utility maximization. The merits of this approach and the properties of the structured logit are discussed. Section 1 discusses some of the major considerations in specifying the form of the ap-

pliance demand model and presents the nested structure used in this analysis. Section 2 describes the calculations of the explanatory variables and the data sets upon which they were based. Section 3 presents the empirical results and discusses some of their implications. The paper concludes with some illustrative applications of the calibrated models to predict space heating, water heating, and air conditioning installations under different conservation policies. (MCW)

35014 (EPRI-EA—1961, pp 2.1-2.60) **Probability choice models and household space conditioning systems.** Reddy, B.J. (Charles River Associates Inc., Cambridge, MA). Aug 1981. NTIS, PC A15/MF A01. Order Number DE81904228.

From Workshop on the choice and utilization of energy-using durables; Boston, MA, USA (1 Nov 1979).

A detailed analysis of the factors that affect household space conditioning choices is presented in Section 1, concentrating on the major fuels and space conditioning options available to households. The second section reviews a number of different discrete choice models, the most important classes of which are the multinomial logit and multinomial probit models. Each assumes that the utility that an individual obtains from choosing an alternative can be written as a linear function of the characteristics of the alternative, the unknown parameters, and an error term. Each further assumes that an individual will select the alternative that provides the greatest utility. The probit model is much more flexible than the logit model, but it is rather difficult to estimate. A preliminary version of a space conditioning choice model is specified and estimated. (MCW)

35015 (EPRI-EA—1961, pp 3.1-3.39) **Econometric analysis of residential electric appliance holdings and consumption.** Dubin, J.A.; McFadden, D. (Massachusetts Inst. of Tech., Cambridge). Aug 1981. NTIS, PC A15/MF A01. Order Number DE81904228.

From Workshop on the choice and utilization of energy-using durables; Boston, MA, USA (1 Nov 1979).

Micro-simulation studies have attempted to model jointly the demand for appliances and the demand for electricity by appliance. Within this context it becomes important to test the statistical exogeneity of appliance dummy variables typically included in demand for electricity equations. If the demand for durables and their use are related decisions by the consumer, specifications which ignore this fact will lead to biased and inconsistent estimates of price and income elasticities. The present paper attempts to test this bias using a subsample of the 1975 survey of 3249 households carried out by the Washington Center for Metropolitan Studies (WCMS). Matched with these observations were the actual rate schedules faced by each household. In Section II, a unified model of the demand for consumer durables and the derived demand for electricity is discussed. In Section III, the econometric issues involved in the estimation of discrete/continuous choice models are discussed. A numerical experiment is reported in Section IV. A joint water-heater space-heater model is introduced and estimated in Section V. In Section VI, the estimations and specification tests of demand for electricity equations under alternative assumption are concluded. Results are summarized in Section VII and variable definitions and constructions are discussed in the appendix. (MCW)

35016 (EPRI-EA—1961, pp 4.1-4.36) **Discrete choice model for new technologies and its application in modeling market penetration.** Burton, E. (Charles River Associates, Inc., Cambridge, MA); Jackson, J.R.; Kaserman, D.L. Aug 1981. NTIS, PC A15/MF A01. Order Number DE81904228.

From Workshop on the choice and utilization of energy-using durables; Boston, MA, USA (1 Nov 1979).

The objective of this study is to develop an empirical discrete choice model for space heating and cooling system combinations and to incorporate the model in a simulation framework with the other two primary determinants of market penetration - growth to the capital stock and replacement of the existing stock. The market penetration of a new technology is then evaluated to examine the interaction of the three components in the market penetration process. The results of this study indicate one approach to utilizing the achievements in discrete choice modeling in the study of market penetration issues.

35017 (EPRI-EA—1961, pp 6.1-6.47) **Econometric models of choice and utilization of energy-using durables.** Brownstone, D. (Princeton Univ., NJ). Aug 1981. NTIS, PC A15/MF A01. Order Number DE81904228.

From Workshop on the choice and utilization of energy-using durables; Boston, MA, USA (1 Nov 1979).

A new disaggregated econometric model of consumer's joint choice of efficiency and utilization of energy-using durables is developed. This model is designed to provide short and medium-run estimates of changes in appliance saturations and utilization rates resulting from energy taxes, efficiency taxes, and/or appliance efficiency standards. The methodology developed is based on the neoclassical assumption of constrained discounted expected utility maximization, thus the household's utility functions are the structural core of the model. The illustrative example focuses on the demand for residential air conditioners and their utilization rates. Section I gives a non-technical overview of the proposed methodology and discusses the types of policy questions which can be answered using this approach. The second section describes the data required to estimate the model, and briefly summarizes what data are available. The next section gives the detailed econometric model, and the final section gives some empirical results from estimations with one version of the model. These empirical results are given to show the computational tractability of the model and to present some preliminary specification test results. (MCW)

35018 (EPRI-EA—1961, pp 9.1-9.39) **Understanding residential/commercial energy conservation: the need for data.** Hirst, E. (Oak Ridge National Lab., TN). Aug 1981. NTIS, PC A15/MF A01. Order Number DE81904228.

From Workshop on the choice and utilization of energy-using durables; Boston, MA, USA (1 Nov 1979).

Different types of data sources that provide information on energy use patterns in the residential and commercial sectors are discussed. The discussion is based on experiences at the Oak Ridge National Laboratory as a builder of energy use models and a policy analyst and experiences as an evaluator of Minnesota energy conservation programs. Existing and emerging data bases are cited. A study in macro-statistics shows the overall trends in residential and commercial energy uses and a micro-statistical study deals with detailed data on the components and determinants of these overall trends. (MCW)

35019 **(EPRI-EM—1506-Vol.1) Solar heating and cooling of buildings (SHACOB): requirements definition and impact analysis-II. Volume 1. Energy-conserving design for residential structures.** Cretcher, C.K. (Aerospace Corp., El Segundo, CA (USA). Energy and Resources Div.). Nov 1980. 140p. NTIS, PC A07/MF A01. Order Number DE82900206.

The results are presented of an analysis of the impact of stringent energy conserving building standards on electric utility service areas and their customers. The reference standard generated for this analysis deals essentially with improvements in insulation, reduction of infiltration losses and control of solar heat gain. The demands on the seven broadly representative electric utilities are determined from detailed simulations of loads and HVAC systems for a set of representative buildings. These demands are then aggregated to represent the total new construction electric heating demands in the years 1990 and 2000 to be compared to the aggregate obtained similarly for a nominal, less stringent standard, viz., ASHRAE 90-75. Results presented include the percentage of energy savings achieved in both heating and cooling seasons and typical demand profile changes. A utility economic impact analysis is performed for the cases investigated to determine changes in operating costs and potential capacity sales. A third cost component considered is the incremental cost of superinsulation (over ASHRAE 90-75) to the customer. The aggregate net cost to the utility/customer entity is utilized as a measure of averall economic benefit. Also analyzed are the effects of superinsulation on the design and performance of solar heating systems considered as an energy saving alternative of adjunct.

35020 **(LBL—12924) Infiltration and indoor air quality in energy efficient houses in Eugene, Oregon.** Lipschutz, R.D.; Girman, J.R.; Dickinson, J.B.; Allen, J.R.; Traynor, G.W. (Lawrence Berkeley Lab., CA (USA)). Aug 1981. Contract W-7405-ENG-48. 50p. NTIS, PC A03/MF A01. Order Number DE82000971.

Measurements of infiltration rates and indoor pollutant levels in houses incorporating energy-conserving measures can provide important information about the effectiveness and health effects of such measures. Twelve energy-efficient houses in Eugene, Oregon were measured for effective leakage area using blower door fan pressurization. Air exchange rates over a period of several hours were determined by tracer gas decay analysis. The results of these measurements were used in conjunction with the LBL infiltration model to predict average annual and heating season infiltration rates. Measured leakage areas and infiltration rates were found to be quite low in comparison to other groups of test houses in North America. Average specific leakage areas for the 12 houses was 2.8 $cm^2/m^2$ as compared to 6.4 $cm^2/m^2$ for post-1975 California housing. The average heating season infiltration rate was calculated to be 0.34 air changes per hour. Infiltration rates measured from tracer gas decay ranged from 0.08 to 0.27 air changes per hour. Indoor concentrations of radon, formaldehyde, and nitrogen dioxide were measured in four of the twelve houses. Radon levels were found to be insignificant. Nitrogen dioxide concentrations were low in all four houses, although levels in the two houses where occupants smoked were slightly elevated by comparison to the two houses without smokers. Levels of formaldehyde comparable to or half of the most restrictive existing guideline were found in all four houses. Furniture and/or building materials are believed to be the source of this pollutant.

35021 **(ORNL—5801) Assessment of seasonal-efficiency models for natural-gas-fired residential furnaces.** Domingo, N.; Keshock, E.G. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 81p. NTIS, PC A05/MF A01. Order Number DE82000499.

Several methods for determining the seasonal efficiency and operating costs of residential fossil-fuel-fired heating systems are found in the literature. In this report, four computer models for determining such efficiency, the Honeywell HFLAME model, the National Bureau of Standards DEPAF model, the Institute of Gas Technology SPACE-FI model, and the Carrier Corporation model, are separately described, discussed, and evaluated in relation to their use in predicting seasonal performance of residential gas-fired heating systems. The detailed discussion of these four models is preceded by a brief description of the characteristics of present gas-fired furnaces and a discussion of the efficiency terms used in this report. The well-established energy estimating methods of the American Society of Heating, Refrigeration, and Air-Conditioning Engineers are described and evaluated, and sources of inefficiency related to these methods are presented. A general conclusion is that purely analytical estimations of seasonal furnace efficiencies are not generally reliable principally because of: (1) a variety of furnace designs; and (2) the different infiltration characteristics of homes. Finally, recommendations are offered concerning possible actions to improve predictions of furnace seasonal efficiency.

35022 **Effective use of electricity in buildings.** London, England; Institution of Electrical Engineers (1980). 224p. (CONF-8004153—). Institution of Electrical Engineers, New York, NY.

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

A separate abstract was prepared for each of 39 papers presented at the conference. (MCW)

35023 **Peak load controlled storage systems for domestic water heating and space heating.** Hubbard, R.W. (Waitemata Electric Power Board, Auckland, New Zealand). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 1-4(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

A description is presented of the experience of the Waitemata Electric Power Board in New Zealand in the areas of storage water heater systems and storage heating systems. The paper describes the operating experience with the systems in terms of: economic reduction in the purchase of power by the consumer; the considerable reduction to the Supply Authority in terms of peak load kilowatt charge and system loss; the reduction in capital and operating costs to the Central Generating Authority through not having to supply demand. The use of each system in terms of generation, distribution, and consumer satisfaction is evaluated.

35024 **New approach to an old off-peak idea.** McGrath, S.T. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 5-8(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Design of a low-pressure water storage heating system to compete with oil-fired low-pressure hot water radiator central heating in Ireland is discussed. The system consists of a heating unit and separate storage vessels, with most Irish houses requiring two storage vessels. Each vessel is cylindrical with a volume of 500 liters. The heat distribution is by a conventional low-pressure hot water radiator system sized for a flow water temperature of 60°C. A description of the controls, performance, and field trials is given. A parallel project undertaken to examine the feasibility of replacing the electro-mechanical controls with a microprocessor based system is discussed. (MCW)

35025 **Electric ceiling heating: its contribution to the means of effectively utilizing electricity for space heating.** Bjerkeseth, E.J.; Scriven, A.E. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 9-19(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Historical aspects of utilizing electricity for space heating are reviewed. Specifically utilizing electric heat elements installed in ceilings in all types of buildings in Norway is described. Use and design of the ESWA vent for the elements are discussed. Use of ESWA ceil heating is compared with the use of storage heaters in similar dwellings in Germany and results are indicated. The experience with ESWA ceiling heaters in UK is reviewed. (MCW)

35026 **Visual comfort: a basis for lighting design.** Bell, J.A.M. (Univ. of Manchester, England). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 20-22(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Standards considered for visual comfort are examined with such matters as cohesion, rhythm, scale, and appropriateness mentioned. Visual comfort and the engineering of light, visual comfort design, and an approach to visual comfort are discussed. (MCW)

35027 **Lighting: effect and affect.** Depledge, G.T.; Pavey, K.C. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 23-27(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

An approach to combine talents of architects and engineers to produce effective lighting in a building is discussed. The approach proposed relates design to the subjective and objective needs. A basis for effective design, the design process, and the design criteria are discussed. (MCW)

35028 **Optimum lighting in architecture.** Phillips, D. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 28-32(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Energy targets for lighting of buildings are studied. Present practices and codes in Great Britain and the USA are reviewed. (MCW)

35029 **Small diameter and triphosphor lamps, the answer to efficient lighting in the eighties.** Inhelder, H.R. (WOTAN Lamps Ltd., London, England). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 33-36(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Recent developments in the technology of fluorescent lamps are described. Efficiency and design criteria of small bulb diameter and triphosphor lamps are discussed. Their advantages are listed. (MCW)

35030 **Light sources related to requirements.** Neal, V.G. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 37-40(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

The most efficient light sources for specified applications are discussed. Low and high pressure sodium, mercury halide, fluorescent, mercury fluorescent, tungsten halogen, and incadescent lamps are considered in view of the general requirements of colar appearance, color rendering, and starting and restarting characteristics. (MCW)

35031 **Energy implications of flexible lighting controls.** Crisp, V.H.C.; Ure, J.W. (Building Research Station, Watford, England). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 41-45(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

A brief review of studies on lighting use that have led to a greater understanding of the way people control their own lighting is presented. The understanding leads to a proposal for a particular form of lighting control that is likely to save energy as well as satisfy user requirements. An installation in a group office space on the 8th floor of a 22-story office building using a commercial control system is described. The system consists of a control module incorporating a power supply, time switch, and a photoelectric control device connected to a photocell mounted in the space itself. (MCW)

35032 **Low energy task lighting systems.** Page, R.K.; Bedocs, L. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 46-50(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

The development of five lighting systems and their hardware for general local and localized lighting schemes are described. Schemes are given for: small office areas, large open areas, combined ceiling and desk lights, uplighter luminaire (indirect lighting), and combined uplighter and desk-mounted luninaire.

35033 **Integrated light-air-systems for high visual comport with emphasis on energy conservation.** Hentschel H.J. (Siemens AG, Traunrent, Germany). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 51-55(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Complex lighting-air conditioning-ceiling systems installed in administrative buildings and open-plan offices are considered. Some of the correlations that can be mathematically expressed on an energy balance basis are noted, but full-scale experiments are often the only way of optimizing this integrated system to achieve greater visual comfort and reduced power consumption. The laboratory at Traunrent with facilities of full-scale tests of Integrated-Light-Air-Systems, of noise-measurements in a new reverberation-room, and of energy-balance calorimetric measurements is described. (MCW)

35034 **Computerized lighting controls: a case study.** Foulner, N.R. (Steensen Varming Mulcahy and Partners, Edinburgh, Scotland). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 56-59(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

The Scottish Widows Fund and Life Assurance Society's new Head Office in Edinburgh, a landscaped office building, is described. The building is air conditioned using a variable air volume (VAV) system with the extracted air being drawn through the luminaires which provide the main heat source. The lighting system comprises continuous runs of recessed fluorescent luminaires with low brightness transverse louvres providing a normal lighting level of 800 lux. The lighting is controlled in 105 groups (points) from a central control unit which has a minicomputer as the main control element. The computer is programmed to provide lighting on/off functions to suit the building requirements. The control system, the equipment, costs, and the advantages and disadvantages of the system are discussed. (MCW)

35035 **Security lighting criteria.** Baker, J.E.; Boyce, P.R. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 60-64(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Principles which directly relate to the use of fences as a physical barrier with a lighting system are examined. The influence of lighting on such a system is discussed. The choice of a light source is largely governed by efficiency, and on this basis, it is recommended that a low pressure sodium discharge lamp be used. Data are tabulated on lamp characteristics, installation costs, and energy efficiency and cost. (MCW)

35036 **Emergency lighting.** Bedocs, L. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 65-70(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Two British standards covering the installation of emergency lighting (cinemas and premises) are briefly described. The advantages and disadvantages of self-contained and central emergency lighting schemes are listed. Information on luminaire construction, luminaire testing and data, and scheme planning and maintenance is presented. The energy that may be saved with proper equipment selection and scheme planning with well-maintained self-contained luminaires in an emergency lighting installation is noted. (MCW)

35037 **Energy-effective lighting in buildings.** Vermeulen, I.J. (N.V. Phillips' Gloeilampenfabrieken, Eindhoven, Netherlands). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 71-74(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

The development of fluorescent lamps is reviewed briefly. Building design, heating, air conditioning, ventilation, acoustics, lighting, and energy consumption are discussed from the viewpoint of the lighting engineer. (MCW)

35038 **Structured ceilings in offices.** Boyce, P.R. (Electricity Council Research Centre, Capenhurst, England). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 75-78(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Measures adopted to control the distribution of light in office buildings are examined. A recent approach for such a distribution system is the use of a structured ceiling in which is located bare lamps. The structure controls the light distribution by reflection and limits the discomfort glare produced by shielding the lamp from direct view from many positions. Implications of and requirements for using this approach are considered. (MCW)

35039 **Energy consumption by variable air volume systems.** Jones, W.P. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 79-86(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

The characteristics of constant volume and variable air volume systems are briefly compared, the energy conservative nature of the latter being noted. A computer study of the electrical energy consumption of a variable air volume system of air conditioning in a model building is described, based on meteorological data for Kew. Account is taken of the proportional band of the pressure sensor regulating fan capacities, the turn-down ratio of the air distribution terminals, and fan efficiencies to calculate the elec-

trical energy consumed throughout a typical working year. Some comment is made on thermal energy consumption. Conclusions are drawn that indicate the benefit to be obtained by using variable air volume systems and suggestions made for getting the best performance from them.

35040 **Spacing of air supply diffusers.** Dickson, D.J. (Electricity Council Research Centre, Chester, England). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 87-90(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

An approach is suggested for simplifying the choice of correct spacing of ceiling air supply diffusers. The method described depends on satisfying an air charge rate condition and a throw condition simultaneously. The air charge rate condition, defined by the diffuser layout and ceiling height, is expressed as a graph of diffuser spacing versus air flow per diffuser. (MCW)

35041 **Control of fan power in building ventilation.** Courtier, G.A.C.; Noon, C.L.B. (Woods of Colchester Ltd., England). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 91-95(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Requirements for reducing fan power of ventilation systems are discussed. Some design features of simple and complex ventilation systems and system components are described. Considerations leading to some general guides to fan selection, when system calculations can only provide an imprecise specification of fan pressure, are noted. The case for energy savings with variable air volume systems is described. (MCW)

35042 **Ultraviolet/ozone method of odour control.** Barker, R. (Electricity Council Research Centre, Chester, England). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 96-99(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

The nature of odors and the development of a deodorizer constructed for testing in a room are described. The device draws air through a mechanical filter to flow axially past a 45-watt low pressure mercury lamp, through a bed of activated carbon, and out through a fan and an iris which was used to control the air-flow rate over the range 400 to 1700 l/min. Various types of charcoal and depths of bed were tested with this device to determine the most efficient depth for ozone destruction. The destruction of maladorant by this device was monitored and measured. (MCW)

35043 **Energy management in government buildings.** Cracknell, R.C.; Taylor, B.A. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 100-104(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

The work undertaken by the Property Services Agency of the Department of the Environment on energy conservation and energy management aimed at reducing the operating cost of the existing UK Government Estate is described. Important successful conservation measures described are client-implemented measures, capital investment, and plant management. (MCW)

35044 **Electrical energy monitoring: a comprehensive task.** Payne, D.J. (Greater London Council, England). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 112-116(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

The scope for individual electrical energy monitoring and recording procedures and equipment are discussed with emphasis on commercial buildings. Areas of major importance and benefit are identified. Aspects that make the exercise worthwhile include such matters as: relating the collected data to the weather; investigating significant variations; and advising users of the pattern of consumption and seeking the cooperation of the users. The specific programs of the Greater London Council and the Inner London Education Authority are examined. (MCW)

35045 **Design for energy management: a case study.** Vick, P.S.; Marriott, A.J. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 117-121(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Planning for the design layout and all mechanical features of a building is discussed, and the specifics of designing the Central Electricity Generating Board building are described. Consideration of all features of a building in the design stage is emphasized. (MCW)

35046 **Efficient use of electricity in larger buildings.** Taylor, J.E. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 122-128(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

This paper considers two examples of the construction of energy efficient buildings; the features are common to most designers, but illustrate two different solutions to the application of electricity and heat recovery. Not only is the detail design approach different in each case but the first case history building has been operating successfully for the past seven years and is well documented, while the second example has been completed recently and reflects later design thinking. The first of these is Eastern Electricity's Area Office at Bedford: an office building with its total energy needs supplied via a cable, widely recognized as offering a particularly successful building design and winner of the 1975 Office of the Year Award for cost effectiveness of the best accommodation solution and quality of the environment. The second study is St. John's Hospital, Peterborough: a geriatric unit which is the first hospital in this country to use electricity as the only form of energy in the building. (MCW)

35047 **Ventilating systems incorporating heat recovery: a case study of the thermal wheel technique in an industrial application.** Shaw, K.A. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 129-134(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Refurbishing a bus garage is described with emphasis on the space heating system for the enclosed workshop area. Some modifications proposed are changing the oil-fired boiler system to a gas-fired low-pressure hot water system and incorporating a thermal wheel in the air handling equipment for the workshop. The thermal wheel transfers heat from the exhaust air to incoming fresh air. Savings realized from the installation of the heat recovery system are noted. (MCW)

35048 **Energy management system at Manhattan Plaza, New York City.** Schnieper, P.A.; Fisher, D.S.; Muller, C.R. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 135-139(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

The energy management system at the Manhattan Plaza, a twin-towered, 45-story apartment complex, is discussed. The layout of the building is described. Energy savings are achieved by control of the 1500 incremental heating/cooling units, common unit fans and the commercial electrical loads with a DECABIT ripple control system. Commercial tenants include a bank, restaurants, florist, and a supermarket. (MCW)

35049 **Microprocessor based energy management systems.** Jenvey, D.R.; Clarke, H.M. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 140-144(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Basic ways that savings in electrical costs can be achieved by the use of microprocessors are described. These include demand control, correct scheduling, and taking into account building capacity and occupancy levels. Installation, safety and reliability, flexibility, and effect on plant maintenance are discussed. Savings that

have been made by the application of microprocessors in a 14-story office building and a modern hotel are briefly described. (MCW)

35050 **Heat pump opportunities for the home.** Brundrett, G.W. (Electricity Council Research Centre, Chester, England). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 145-148(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Thermal comfort in existing and new houses is discussed. For existing buildings the solution is the combination of insulation techniques wherever practicable together with an air-to-water heat pump as a substitute for the present boiler system. For new houses the solution is to install much higher levels of insulation, together with some form of ventilation control and electrical air treatment. These two approaches are described. (MCW)

35051 **Effect of increasing house insulation on electric heating equipment design.** Siviour, J.B. (Electricity Council Research Centre, Chester, England). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 149-154(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

The principal performance characteristics of electric space heating equipment operating in a highly insulated house are discussed. Free heat from people, lighting, appliances, and sunshine has the potential to provide a large proportion of the total space heating needed. However, much of it is produced over short periods in restricted parts of the house and may be released with steam and odors. Its release is largely uncontrolled and this could lead to serious overheating unless the heating system is designed and operated so that its output is in opposition to the free heat release so that together they produce the required heating rate. To illustrate the principal features, a semi-detached house is used, typical in all respects except for the level of insulation. This is set at double glazing and a U-value of 0.3 $W/m^2K$ for the floor, walls and roof, about two and one half times better than the minimum under the current Building Regulations. It is assumed to be occupied by a typical family of two adults and two children. First the annual energy flows are considered. Then the average daily energy and power gains and losses are assessed. Finally, individual room heating requirements are discussed.

35052 **Study of 38 all electric, occupied houses designed to a high standard of insulation.** Miller, A.J. (Univ. of Newcastle upon Tyne, England). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 155-158(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Measurements of internal air temperatures, energy consumption, hot water consumption, and usage of extract and supply fans were made over two and a half years in 38 occupied all-electric houses built at Washington New Town, Tyne, and Wear. The house design, the systems, and heat losses are discussed. (MCW)

35053 **Low-electricity future household.** Norgard, J.S. (Technical Univ. of Denmark, Lyngby). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 159-163(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Utilization and efficiency of electrical appliances and electricity consumption are discussed for a model household in Denmark. (MCW)

35054 **Low energy building design.** Croome, D.J.; Parker, K.J. (Univ. of Bath, England). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 164-175(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Energy flow patterns in buildings behaving as energy systems, and available sources of energy are discussed. The effective use of ambient energy and passive environmental control in low energy buildings are described. Objectives for designing a low-energy house are given and solutions to implement the measures are noted. The measures recommended are used to determine the form of an experimental low-energy house; the details of which are presented in the appendix along with some construction and heating requirements for a standard and an insulated house. (MCW)

35055 **Heatbank project in Victoria, Australia.** Cochrane, I.C. (Univ. of Melbourne, Australia). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 176-180(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Generation of electric power in Australia is briefly discussed. The Heatbank project, conceived to research and assess the effects of domestic storage space heating appliances on the electrical energy system, is described. Criteria for suitable testing sites (domestic residences) and the selection of six sites are noted. The Project identified an energy monitoring requirement, of the status or event type, for load research applications. The monitors, based on paper-chart pen-recorders, are described and the data acquired indicate that fan storage heaters used in Victoria residences are suboptimal, contributing little to the system base load. (MCW)

35056 **Energy conservation in offices: an investigation of localized lighting.** McKennan, G.T.; Parry, C.M.; Tilic, M. (Welsh School of Architecture, Cardiff, England). *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 189-196(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

A study of task lighting is described, and some implications for energy conservation are discussed. Emphasis was placed on evaluating a range of currently available luminaires in a realistic office setting. A four-person simulated office atmosphere was used as an example. The study comprised two parts. In the first part the luminaires were chosen with one exception from those currently available on the market and together with a uniform installation comprise a total of 9 installations studied. Indirect background lighting system was used with each of the task luminaires. Because indirect systems are inherently inefficient all the task lighting installations had relatively high electrical loadings. The second part of the study was an evaluation of an installation comprising the most preferred task luminaire from the first part of the study with a more efficient direct background installation. (MCW)

35057 **Integrated ceiling system: its contribution to energy management.** Smith, P.W. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 197-202(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

The advantages of an integrated ceiling system are discussed. The system can save building materials by allowing for reduced height. The paper focuses on integrating the comfort systems (lighting, heating, air conditioning, fire detection and suppression) in a design to make the most of the electrical energy employed. Specifically discussed are the air handling luminaire, shaped ceilings, modular luminaires, negative plenum exhaust, air diffusion. Surveys were conducted of installed integrated ceilings to determine the reaction of the occupants to the comfort conditions. An attempt was made to establish which energy saving features are effective. Results are discussed. (MCW)

35058 **Advanced air conditioning design facilitates rehabilitation of a London landmark: Couttes Bank.** Smith, T. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 203-212(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

Rehabilitation of the Coutts Bank building in London, the design concept, and the new building layout are described. Information and design features of the space HVAC systems, the building envelope, heat recovery equipment, and control systems for services for the Strand Entrance Hall, the Centre Court, and the three office floors are described. Additional descriptions of systems

to complete the ventilation and air conditioning systems are presented. (MCW)

35059 **Distributed data acquisition and control system for building engineering services.** Barney, G.C. (UMIST, Manchester, England); Freitas, V.L.B. *IEE (Institution of Electrical Engineers) Conference Publication ;* No. 186, 213-217(1980). (CONF-8004153—).

From International conference on effective use of electricity in buildings; London, UK (29 Apr 1980).

The variety of services in a building is categorized. A reference to their control systems is made. The concept of a distributed data acquisition and control (D-DAC) system is then described in detail. Finally, the paper reviews experience gained in implementing a D-DAC system for a five floor building containing a representative number of engineering services.

## 3202 Transportation

35060 **(CONF-8104103—) Symposium on commercial-aviation energy-conservation strategies.** (Department of Energy, Washington, DC (USA); Federal Aviation Administration, Washington, DC (USA)). 1981. 373p. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

Separate abstracts were prepared for 17 papers presented at the symposium. (MCW)

35061 (CONF-8104103—, pp 3-29) **Potential fuel savings through improved airframe maintenance.** Covey, R.R. (Aerospace Corp., El Segundo, CA); Pershing, B.M.; Knight, R.S. 1981. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

This paper presents preliminary results obtained from a program comprising an analytical projection and the flight verification of potential fuel savings obtainable through improved airframe maintenance of commercial jet transport aircraft. Realization of the savings depends on the removal of drag inducing airframe discrepancies incurred in normal revenue service. In the two-task program, one task developed and utilized methods to project analytically the potential improved airframe maintenance-related fuel savings of each aircraft in a fleet of 15 DC-10's. These projections were formulated using a discrepancy data base developed from detailed physical inspections of each aircraft. The second task addressed the verification of fuel savings through the collection and analysis of pre- and post-maintenance flight performance data obtained on two of the DC-10's while in normal revenue service. Based on multivariable linear regression analyses of the flight data, one aircraft showed a decrease in fuel consumption of 0.4% at a confidence level in excess of 98%, compared to an analytical projection of 0.6%. Flight verification results from the second aircraft were inconclusive due to collection of a significant block of data under unstable flight conditions. Cost effectivity studies of improved airframe maintenance are currently in progress.

35062 (CONF-8104103—, pp 31-43) **Development of a procedure for calculating the effects of airfoil erosion on aircraft engine compressor performance.** McMillan, O.J. 1981. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

A research program to determine a procedure to assess in detail the effects of fan or compressor airfoil erosion on JT8D fuel consumption is described. The first step in this program (currently ongoing) combines an existing throughflow program with results obtained from an existing combined viscous-inviscid blade-to-blade analysis to determine the effects on JT8D compressor performance of changes in fan or compressor blade shape. Samples of JT8D blade sections under new and eroded conditions obtained in this program are presented. It is shown that although the new blades have sample-to-sample variability that is easily apparent and of the same order as changes in blade shape caused by erosion in some locations in the engine, much larger changes in blade shape are caused by erosion in other locations. The way in which the procedure being developed is used to ascertain the sensitivity of the compressor performance to these various levels of blade-shape change in the different locations is described.

35063 (CONF-8104103—, pp 45-56) **Aircraft towing feasibility study.** Fan, H.S.L.; Haney, D.G. (Peat, Marwick, Mitchell and Co., San Francisco, CA). 1981. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

The feasibility and constraints of towing loaded aircraft between runways and terminal gate areas as an energy conservation measure are examined. Safety concerns are identified; the state-of-the air in towing equipment is reviewed; and the operational effects of towing are assessed. The actual effects of extended aircraft towing on airfield operations at any airport depend on the specific characteristics of that airport, including the physical layout of the passenger terminal and gate area, runways, taxiways, and roadways; ground movement patterns; runway use; the types and number of aircraft using the airport; and congestion levels. These characteristics and their operational implications at 20 large airports were analyzed. Some unresolved issues such as questions on radio communications, flight check procedures, and congestion are noted. (MCW)

35064 (CONF-8104103—, pp 57-77) **Analysis of integrated fuel efficient, low noise procedures in LAX terminal area operations.** McKinley, J.B. (Systems Control, Inc., West Palm Beach, FL); Bowles, R.L. 1981. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

This paper addresses terminal area fuel conservation and airport noise level relationships to quantify the potential fuel savings and noise level reduction in the Los Angeles International (LAX) terminal area between 1980 and 1990. To FAA computer models were used to determine the potential. The Integrated Noise Model (INM) Version 2.7, was used for noise analysis, and LINKMOD, a preliminary fuel burn model, for the fuel analysis. The results of this detailed analysis revealed that due to the changing aircraft mix at LAX to include more wide body aircraft and fewer narrow body aircraft operations, airport noise level will decrease slightly, but significantly for 1985 and 1990, respectively, from the 1980 baseline. In addition, there is demonstrated a 4.5 million gallon fuel savings yearly in 1985, and 5.0 million gallons yearly in 1990. Unconstrained terminal procedures analysis exhibited an unacceptable increase in airport noise level between 1980 and 1985. This increase occurs over water on departure, where the largest noise absorption takes place. Approach noise showed no change with unconstrained procedures. Annual fuel savings due to unconstrained procedures proved to be substantial. For 1985, a fuel savings of 29.8 million gallons early demonstrated, in addition to the 4.5 million gallons due to wide body traffic mix changes. In 1990, annual fuel savings are 31.0 million gallons due to unconstrained procedures at the LAX terminal area.

35065 (CONF-8104103—, pp 81-93) **Overview of the DOT/FAA aviation energy conservation policy.** Hoch, C.J. (Federal Aviation Administration, Washington, DC). 1981. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

The basic principles upon which the Federal Aviation Administration policy is based are described. Some of the statistics bearing on aviation's use of energy are reviewed and some programs implemented to save fuel are noted. The policy which states that the FAA will promote aviation energy conservation in both the present and future operation of the National Aviation System and will act to insure aviation's equitable share of energy is discussed. Specific policy actions categorized into five program areas are: Air Traffic Control (ATC)/Flight Operations Program; Upgrades ATC Systems and Procedures; Airport Program; Aircraft Technology Program; and Internal FAA Program. Thirty-one subprogram elements in the five programs are listed. (MCW)

35066 (CONF-8104103—, pp 105-125) **Airline flight planning: the weather connection.** Steinberg, R. (Lewis Research Center, Cleveland, OH). 1981. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

Airline flight planning has shown little improvement in accuracy since the introduction of computerized techniques in 1964. This has primarily been, because both the type of weather product utilized by the carriers and the way they have employed it has remained unchanged over the past 15 years. The airlines now have an opportunity to make a significant advance in this area with attendant benefits in fuel savings. Most of the technological ingredients are in place, but it will take increased cooperation between government and the private sector if cost effective improvements are to be made on a reasonable time scale. This paper reviews the meteorological basis for the present method of flight planning and analyzes its impact on current flight operations. A new approach is suggested for developing a weather data base, for flight planning, which has the potential of providing a fuel savings of between 2 and 3% on long distance flights.

35067 (CONF-8104103—, pp 127-136) **Flight preparation and planning.** Schooley, B. (United Airlines, Denver, CO). 1981. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

United Airlines' flight plans produced by AFPAM, Automated Flight Planning and Monitoring, are described. The data base from which the flight plan is constructed, consisting of airplane performance data, forecast weather data, city-pair route data, the corporate flying schedule, and other data, is discussed. Corporate policy selection of a flight plan, the computation of the plan, and its operational application are also discussed. (MCW)

35068 (CONF-8104103—, pp 137-145) **Fuel conservation techniques in Jet Transport Aircraft operations.** Craven, H.H. Jr. 1981. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

This paper examines in detail the operational procedures recommended by the aircraft manufacturers and suggests some reasonable alternatives when air traffic control or flight conditions make those procedures either impractical or impossible. Basic aerodynamic considerations are involved with emphasis on its effects on engine and aerodynamic efficiency. Included are a density altitude chart with weight limitations for the B-747-1/7A Thrust aircraft, a fuel planning graph for the same airplane, some comparative power charts, and computer run-offs to help substantiate the information in the paper. The principles involved in this paper apply to any aircraft, but performance specifications are in reference to the Boeing 747-1.

35069 (CONF-8104103—, pp 147-153) **Air traffic control: its effect on fuel conservation.** Price, E.H. 1981. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

Programs implemented by the Federal Aviation Administration and programs initiated by users to help airlines save fuels are listed. The dependency of the success of the procedures upon the air controllers is described. Correlations of airport capacity, noise abatement procedures, mixed-size aircraft operations, the enroute environment, and utilization of special use airspace with energy efficient operations are discussed in detail. (MCW)

35070 (CONF-8104103—, pp 155-161) **Fuel conservation during descent.** Anderson, N.F. 1981. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

The external and internal environment of an aircraft is considered to achieve minimum fuel usage during descent. The external environment is beyond the control of the pilot, but liason between aviation administrations with aviation agencies provides information and service which are needed. The internal environment and some of the variables confronting the pilot in his evaluation of the descent distance required from cruise altitude are considered. These include weight, altitude, head or tail wind component, distance, and speed variations. (MCW)

35071 (CONF-8104103—, pp 163-167) **Delay management process.** Brubaker, R.E. 1981. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

Delays of airline flights are discussed. Principles for the imposition of delay management programs discussed are: ground delay, airborne delay, intermediate landing, substitute departure release times, and split delay. (MCW)

35072 (CONF-8104103—, pp 171-208) **Computerized engine and airplane performance monitoring programs.** Schwartz, M.B.; Domke, A.E. 1981. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

An important element among the many fuel conservation activities underway within United Airlines are the computerized engine and airplane monitoring programs. These systems provide on-going information on the condition of each individual airplane and the health of the installed engines. Any airplane or engine performance deterioration is readily apparent and further investigation can be implemented and the necessary action taken. These programs are presented in appropriate detail. Also included in the paper is a discussion of some efforts to audit the effects of performance altering factors. For example, the Cruise Data Survey System used to measure drag differences between reverser configurations on the 727 airplanes is presented. Long term performance deterioriation is discussed and the economic unfeasibility of restoring engines and airplanes to new condition. Recognizing the potential for fuel savings through better controlled ground usage of the auxiliary power unit, steps were taken to monitor its operation. Since this monitoring program has been in effect, over $.5 million in fuel savings monthly have been realized.

35073 (CONF-8104103—, pp 209-230) **Sideslip indication system.** Horst, D. 1981. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

A sideslip indication system that will save fuel is considered. A brief history and development of sideslip indicators are reviewed. Lufthansa's experiences with installing sideslip sensors and methods of gathering data on aircraft are presented. Detailed sideslip measurement data are analyzed for an Airbus 300 aircraft. Results indicate that the sideslip angle is about equivalent to the fuel burn increase in percent. (MCW)

35074 (CONF-8104103—, pp 231-256) **Turbine engine fuel conservation by fan and compressor profile control.** Roberts, W.B. (Flow Application Research, Fremont, CA); Rogers, W. 1981. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

Saving energy by controlling the fan and compressor blade shapes on air carriers is discussed. Cell tests performed during this study are described and results show that fan and compressor shape control can lower fuel burn as much as 2 to 2 1/2% compared to standard refurbishment. Data discussed to verify this improvement pertains to the Pratt and Whitney JT8D series of engines. (MCW)

35075 (CONF-8104103—, pp 259-280) **Practical economic criterion for fuel conservation.** Ferguson, D.R. 1981. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

The value of an airplane's time to an airline when it is in use is discussed. A basic equation for this calculation is given. Speeds

during low altitude cruise, descent, and cruise at normal altitude are discussed to explain how to select the correct speed to optimize a flight profile. (MCW)

35076 (CONF-8104103—, pp 281-306) **Pilot/aircraft fuel performance evaluation.** McKinzie, G.A. 1981. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

Methods by which airlines determine: the extent of their fuel consumption; the manner in which this information can be used to forecast future fuel usage; present measuring systems and parameters for looking fairly and squarely at how the competition is doing; and goals and the way they can be developed and tracked in conjunction and cooperation with overall company objectives are discussed. (MCW)

35077 (CONF-8104103—, pp 345-348) **Commuter airline overview.** Ransome, J.D. 1981. NTIS, PC A16/MF A01. Order Number DE81028406.

From Symposium on commercial aviation energy conservation strategies; Washington, DC, USA (2 Apr 1981).

An overview of Allegheny Commuters airline growth, its impact on the air traffic control systems, and measures being implemented to solve air traffic control and airspace problems is presented. One measure described is the investment by Ransome Airlines (an Allegheny Commuter) in the DASH-7 aircraft for service between Philadelphia and Washington which will result in fuel economy, need for less communication, reduced workload for the flight crew, and reduced airport noise pollution. (MCW)

35078 (DOE/PE/70032—T1) **Impact of fuel-economy shortfall: trends in technology-weighted EPA vs on-road MPG. Periodic analysis memorandum No. 1.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). 1 Apr 1981. Contract AC01-79PE70032. 23p. NTIS, PC A02/MF A01. Order Number DE81030841.

The fuel consumption impacts of revised estimates of the shortfall between the EPA-measured and on-road fuel economy of light-duty vehicles (passenger cars and light-duty trucks less than 8500 lbs GVW) are examined. The analysis uses the DOE Highway Fuel Consumption model to project fuel demand. The technologies and technology-specific shortfall relations are examined. The procedure used to develop aggregate technology-weighted fuel economy shortfall relations for the Highway Fuel Consumption model is outlined. The fuel demand impacts of alternative assumptions regarding technology-specific shortfall are compared. (LEW)

35079 (EPRI-EA—1961, pp 8.1-8.33) **Forecasting the fuel efficiency of household motor vehicle holdings.** Manski, C.F. (Hebrew Univ. of Jerusalem, Israel); Sherman, L. Aug 1981. NTIS, PC A15/MF A01. Order Number DE81904228.

From Workshop on the choice and utilization of energy-using durables; Boston, MA, USA (1 Nov 1979).

This paper reports on efforts to forecast the fuel efficiency of household motor vehicle holdings in the United States through 1985. The work addresses two forecasting questions. First, given the currently envisioned vehicle design changes, what is the likely path of sales-weighted new-vehicle efficiencies through 1985. Second, given the same design assumptions, how will the average efficiency of all vehicle holdings change over time. To answer the first question, one must predict the composition of new vehicle sales. To answer the second, one must predict not only the new vehicle sales mix but the volume of new vehicle sales and the rate of used vehicle scrappage as well. The forecasts presented are the output of a new partial equilibrium model of the operation of the motor vehicle market and of machinery for forecasting with this model. Section II presents a model of the operation of the motor vehicle market. Section III forecasts household motor vehicle holdings. (MCW)

35080 (ANL-Trans—1198) **Transport and energy.** Abriani, A. (Argonne National Lab., IL (USA)). Sep 1981. Translated from Symposium on evaluation and reinforcement of pavements and energy in transportation; San Miguel de Tucuman, Argentina, September 4-6, 1980, pp 103-109. 17p. NTIS, PC A02/MF A01. Order Number DE81030287.

Energy sources used and the growth of energy consumption in the transportation sector in Argentina are discussed. Energy consumption by the transportation sector in some other major countries of the world are briefly noted. Optimizing transportation energy consumption by means of energy conservation is mentioned. Comparisons are made of energy consumed by rail and road vehicles in urban and interurban areas for freight and passenger transport. (MCW)

## 3203 Industry And Agriculture

*REFER ALSO TO CITATION(S) 34432, 34450, 34454, 34478, 34482, 34508, 34509, 34594, 34696, 34952, 34990, 35130, 35375, 35461, 35462*

35081 (ANL/CNSV—16) **Energy and materials flows in the production of pulp and paper.** Hersh, H.N. (Argonne National Lab., IL (USA)). May 1981. Contract W-31-109-ENG-38. 193p. NTIS, PC A09/MF A01. Order Number DE82000890.

A broad overview is presented of the US pulp and paper industry, emphasizing its manufacturing processes and energy requirements at the unit process level. Also discussed are its patterns of energy use, the means it has for coping with energy supply problems, the potential of its forest holdings to supply fuels and chemical feedstocks, recycling, public policy, and actions that could be taken to reduce future fossil fuel demand. The aggregate purchased energy required to make paper from pulpwood is estimated to be $15 +- 5 \times 10^6$ Btu/ton of composite product in 1980, which possibly could be reduced to $7 \text{ to } 10 \times 10^6$ Btu/ton by 1990. The purchased-energy requirement for unbleached kraft pulp is $3 \text{ to } 3.5 \times 10^6$ Btu/ton, which can approach zero in a properly designed mill. The most energy-consuming unit process is paper drying ($5 \text{ to } 9 \times 10^6$ Btu/ton). The industry provides 50% of its fuel requirements from its own resources and is the nation's largest cogenerator of steam and electricity. Thus, the industry is better able to reduce its use of fossils fuels than are other energy-intensive industries.

35082 (CONF-8006187—1) **Sunflower seed oil as an extender for diesel fuel in agricultural tractors.** Bruwer, J.J.; Boshoff, B.V.D.; Hugo, F.J.C.; du Plessis, L.M.; Fuls, J.; Hawkins, C.; van der Walt, A.N.; Engelbrecht, A. (Department of Agriculture and Fisheries, Silverton (South Africa). Div. of Agricultural Engineering). 1980. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE81903440.

From Symposium of the south african institute of Agricultural Engineers; Silverton, South Africa (11 Jun 1980).

The South African government has accepted in principle the use of sunflower seeds as an extender for diesel fuels in agricultural tractors. Production requirements to meet the demand are briefly reviewed. Physical and chemical properties of sunflower seed oil are discussed. Tractor engines using diesel fuel or sunflower seed oil were tested as well as engines using various blends of sunflower seed oil with petrol, diesel fuel, power paraffin, and illuminating paraffin. Results were compared. Engine service life and injection equipment performance are discussed. (MCW)

35083 (DOE/CS/12077—T1) **High-temperature counterflow recuperator. Final report.** Rudloff, F. (Unitex Corp., Salt Lake City, UT (USA)). May 1981. Contract AC07-80ID12077. 324p. NTIS, PC A14/MF A01. Order Number DE81031923.

A summary of the work performed to further evaluate the commercial potential of a helical recuperator design in recovering waste heat from industrial furnaces is reported. The helical recuperator concept consists of a cylindrical column with an interior helical interface which separates the preheat air and the combustion gas. The column operates in a counter flow mode and is formed from modular sections. The work was divided into two general ac-

tivities including a material evaluation and a design optimization. The material evaluation consisted of exposing material samples to a soda-lime glass furnace environment for a fifteen week period. A study of manufacturing was also performed to determine which recuperator designs could be produced and what their corresponding costs of production would be. The results indicated that of the materials tested, ECP-3, X-81, and Unichrome were the best suited for use in a soda-lime environment. Of the materials tested ECP-3 was the best candidate with respect to manufacturing. In the design optimization, two potential design modifications were identified through theoretical analyses. The modifications resulted in a finned design and a double helix design. The assumptions made in the analyses were checked experimentally. Revised analyses based on the experimental and cost data showed that the prototype design was the most economical producing paybacks of 2 to 3 years for modules made of Siltec and 3 to 5 years for modules made of KT Silicon Carbide. Both of these materials are poor candidates for use in the soda-lime glass environment. For materials that showed the greatest potential for use in the glass environment, the double helix design made from ECP-3 was the most economical producing payback periods of 6 to 14 years.

35084 **(DOE/CS/40005—T4) Brayton-cycle solvent recovery system. Phase 1. System optimization.** (AiResearch Mfg. Co., Torrance, CA (USA)). 16 Jun 1980. Contract AC03-78CS40005. 161p. NTIS, PC A08/MF A01. Order Number DE81029749.

The findings of an investigation on potential use of the Braton-cycle for solvent recovery are discussed. Section 3 describes the basic Brayton cycle principle and the various methods of recovering solvents. The presently used solvent recovery systems of carbon and condensation by mechanical refrigeration are described and incineration is discussed as an alternate method to reduce solvent emissions to the atmosphere. Candidate Brayton-cycle systems selected for further evaluation are depressed freezing (closed loop); desiccant (open loop); and carbon desorb. The potential industrial applications for the candidate Brayton-cycle concepts and the market potential that could be expected are described in Section 4. All industries that manufacture, market, synthesize, process, coat, or clean with volatile organics were considered. An economic analysis in Section 5 of the candidate solvent recovery systems shows that the cost of incorporating any of the systems can be justified on the basis of the payback value of the recovered solvent. The method of conducting site surveys is discussed. The 3M tape coating facility located in Hutchinson, Minnesota, was chosen as the demonstration site. Results of recovering solvents from one or another oven zones using the closed loop Brayton-cycle solvent recovery system are detailed. (MCW)

35085 **(DOE/CS/40021—T2) ALINET: a dynamic network model of the food processing and distribution sector. Phase B. Technical report, March 1978-February 1979.** Ducot, E.R.; Levis, I.S.; Levis, A.H. (Systems Control, Inc., Palo Alto, CA (USA)). May 1979. Contract AC03-77CS40021. 170p. NTIS, PC A08/MF A01. Order Number DE81026110.

ALINET (Alimentary Industry Network) is a dynamic network model of the food processing and distribution sector, designed for the analysis of energy use in food production and the evaluation of the effectiveness of energy conserving technologies. This report documents the second phase of the model development. It contains descriptions of: (a) the structure of the wheat system at the state, regional, and national levels; (b) the software for constructing material flow graphs at the various levels of aggregation, as well as the procedures for aggregation and data verification; and (c) the facility data base supporting the flow graph generation.

35086 **(DOE/CS/40259—1) Energy conservation in distillation. Final report.** Mix, T.W.; Dweck, J.S.; Weinberg, M.; Armstrong, R.C. (Merix Corp., Wellesley, MA (USA)). Jul 1981. Contract AC07-76CS40259. 299p. NTIS, PC A13/MF A01. Order Number DE81028650.

An energy audit of major processes in the petroleum, chemical, and natural gas liquids industries and of key columns in each major process indicates that approximately 2 quads of energy were consumed for distillation in the US in 1976. The breakdown of the energy usage by industry is: petroleum refineries, 66%; chemical (including petrochemical) industry, 29%; natural gas liquids processing, 5%. Techniques and current practices for conserving distillation energy are reviewed, and guidelines indicating those process conditions which favor the use of each energy conserving technique are enumerated. Tray and control retrofits are treated in greater depth. Expressions for payout times for these two retrofit options are developed based both on energy savings and on increased throughput. Calculations for industrial columns suggest that both types of retrofits will frequently have short (<6 months) payout times based on either criterion. Extractive distillation is also discussed in detail and criteria enabling the estimation of the energy which may be conserved using this technique are developed. Good housekeeping practices and field techniques for checking the energy efficiency of industrial distillations are also discussed.

35087 **(DOE/CS/40446—T1) Cutting tool coatings program. Final report.** (Alpha Glass, Inc., El Segundo, CA (USA)). Nov 1980. Contract AC03-80CS40446. 47p. NTIS, PC A03/MF A01. Order Number DE81026289.

This project was designed to validate the energy saving potential of hard refractory coatings on cutting tools. One-quarter-inch jobber drills were selected to be coated with the hard refractory compounds of TiC and TiN by the Activated Reactive Evaporation (ARE) process. The TiN-coated drills performed best with tool lives from 2 to 4 times those of the black oxide coated drills, and up to 20 times those of bright drills. This improvement in tool life can be correlated to energy savings as expressed by the criteria of Btu/lb of material removed. Limited direct force measurements were also taken and indicated a reduction in cutting forces of TiN-coated drills over black-oxide-coated drills. A commercial ARE coating system was conceived and analyzed; it was found to be a potentially economical solution to coating a large variety of tools. If coated tools from such a system were fully used in industry, an estimated energy savings of $10^{13}$ to $10^{14}$ Btu/y could be achieved. This report describes the cutting cool program background work, the project tasks, and the results of the project.

35088 **(DOE/ET/25309—T1) Energy savings by means of fuel-cell electrodes in electro-chemical industries. Progress report, February 1, 1981-April 30, 1981.** Bar-Ilan, A.; Juda, W.; Finnigan, B.P. (Prototech Co., Newton Highlands, MA (USA)). 31 Jul 1981. Contract AC02-78ET25309. 26p. (COO—4881-31). NTIS, PC A03/MF A01. Order Number DE81030975.

Life testing of palladium-loaded and low platinum-loaded anodes on type C supports and with type no. 01 current collectors was continued and terminated. Additional life-test data are reported for high Pt-loaded and a second low Pt-loaded anode. The 6 in. x 6 in. depth cell has been operated at reduced hydrogen back pressures, and the effect of the resulting flooding of the hydrogen chamber upon cell performance has been determined. Furthermore, two 6 in. x 6 in. depth cells were fabricated from the same type platinum support and current collector, but following different preparation procedures. Cell performance was compared at various submergence depths under identical operating conditions. In view of their attractive cost/performance characteristics, two groups of type C/sub $\alpha$/ platinum anodes were prepared and tested in zinc electrowinning cells. Finally, a 1 ft. x 1 ft. cell module was designed and constructed, along with a 3 ft. x 3 ft. electrolyte chamber in which the cell will be tested at various depths.

35089 **(EPRI-EM—2037) Techniques for energy conservation in ac motor-driven systems. Final report.** Mohan, N. (Minnesota Univ., Minneapolis (USA). Dept. of Electrical Engineering). Sep 1981. 169p. NTIS, PC A08/MF A01. Order Number DE82900356.

Techniques for energy conservation of reducing losses in ac motor-driven systems proposed by the technical community in response to surging cost of energy are evaluated and compared. Report objectives are to provide better understanding of underlying principles and to evaluate technical and economic viability of these techniques for various applications. An important aspect considered is the impact on electric utility system in terms of harmonics, power factor of operation, and Electro-Magnetic Interference (EMI). The techniques evaluated are: NASA Power Factor Con-

troller, a simple device for reducing power losses in lightly loaded ac motors; wanlass motor modification, a scheme of reconnecting motor windings with capacitors in series, with the intention of improving the motor efficiencies under all loading conditions; conventional variable frequency solid-state inverters which can control the speed of ac motors by producing adjustable frequency ac voltage, with a significant potential for energy conservation in pumps and air-handling systems; and other variable frequency drives and schemes including cycloconverters, slip-recovery scheme, Exxon Alternating Current Synthesizer, Venturini conversion technique, permanent magnet synchronous motors, and a device called the Phase-Liner. The impact of rapid growth in semiconductors and magnetic materials technologies is also considered.

35090 **(ORNL/Sub—80/13847/2) Industrial steam supply system characteristics program. Phase II. Low- and medium-Btu gas-fired boilers with associated gasification plants. Final report.** (Oak Ridge National Lab., TN (USA); Foster Wheeler Development Corp., Livingston, NJ (USA)). Sep 1981. Contract W-7405-ENG-26. 292p. NTIS, PC A13/MF A01. Order Number DE82000535.

Conceptual plant designs, engineering characteristics, and operating requirements were developed for the following systems: on-site gasification associated with gas-fired boilers for low-Btu and medium-Btu gas production, and central gasification facility associated with gas product pipeline for low-Btu gas and medium-Btu gas production. For each of these systems, two coal sources were considered - an Eastern high-sulfur bituminous coal and a Western low-sulfur subbituminous coal. Thus, eight different systems were studied and conceptual cost estimates prepared for each of them. Scaling factors were developed over a range of plant sizes; cost ratios were prepared for multiple unit systems; and cost sensitivities vs degree of sulfur removal were developed for each of the on-site gasification systems.

35091 **(PNL—3981) Analysis to develop a program for energy-integrated farm systems.** Eakin, D.E.; Clark, M.A.; Inaba, L.K.; Johnson, K.I. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1981. Contract AC06-76RL01830. 127p. NTIS, PC A07/MF A01. Order Number DE82000318.

A program to use renewable energy resources and possibly develop decentralization of energy systems for agriculture is discussed. The purpose of the research presented is to establish the objective of the program and identify guidelines for program development. The program's objective is determined by: (1) an analysis of the technologies that could be utilized to transform renewable farm resources to energy by the year 2000, (2) the quantity of renewable farm resources that are available, and (3) current energy-use patterns. Individual research, development, and demonstration projects are fit into a national program of energy-integrated farm systems on the basis of: (1) market need, (2) conversion potential, (3) technological opportunities, and (4) acceptability. Quantification of these factors for the purpose of establishing program guidelines is conducted using the following four precepts: (1) market need is identified by current use of energy for agricultural production; (2) conversion potential is determined by the availability of renewable resources; and (3) technological opportunities are determined by the state-of-the-art methods, techniques, and processes that can convert renewable resources into farm energy. Each of these factors is analyzed in Chapters 2 to 4. Chapter 5 draws on the analysis of these factors to establish the objective of the program and identify guidelines for the distribution of program funds. Chapter 6 then discusses the acceptability of integrated farm systems, which can not be quantified like the other factors.

35092 **Potential for industrial energy conservation in California.** Dornfeld, D.; Benenson, P.; Barnes, R. (Univ. of California, Berkeley). *Journal of Engineering for Industry ;* **103**: No. 1, 52-60(Feb 1981).

The industrial-energy-conservation scenarios developed in this study show the combined effect on energy consumption of implementing a number of conservation measures. The scenarios include assumptions about economic, demographic and behavioral, and technological variables such as population, industrial growth, and conservation implementation levels. The basic approach for the conservation scenario construction is to quantify base year (1974) per capita energy consumption by industrial subsector, reduce per capita consumption by the estimated conservation potential in the appropriate year, and extrapolate by industrial and population growth. The scenario projects significant reductions in energy consumption. The estimated savings of 2.7 x $10^{15}$ Btu (2.9 x $10^{18}$ Joules) in 2020 is approximately 30% less than the estimated energy consumption without conservation. Although the scenario was calculated for California industry, the estimates of individual conservation potentials are applicable to other regions of the United States. 8 refs.

35093 **Efficient dryer operation.** Banta, L.E. (Georgia Inst. of Tech., Atlanta). pp 45-61 of Proceedings of third annual energy seminar. Erie, PA; Gannon University (1981).

From 3. annual energy seminar; Erie, PA, USA (31 Mar 1981).

Mass and energy balancees in an industrial dryer are discussed. A schematic is shown illustrating how mass and energy balances can be set up on any dryer to determine what portion of the energy going into the dryer actually fulfills its purpose to evaporate water. Some aspects of heat recovery from skin losses, product stream losses, and exhaust streams are discussed. A kiln SKINLOSS computer program is described in Appendix A. A dryer air flow optimization program is discussed in Appendix B. (MCW)

35094 **Waste heat recovery from refrigeration.** Jackson, H.Z. (Georgia Inst. of Tech., Atlanta). pp 109-141 of Proceedings of third annual energy seminar. Erie, PA; Gannon University (1981).

From 3. annual energy seminar; Erie, PA, USA (31 Mar 1981).

Waste heat recovery from refrigeration machines is a concept which has great potential for implementation in many businesses. If a parallel requirement for refrigeration and hot water exists, the installation of a system to provide hot water as a by-product of the refrigeration cycle become economically justified. A conservative recovery rate for water at 160°F of 3GPH per ton of refrigeration is possible. The replacement of traditional fuels such as natural gas, fuel oil, and electricity yield savings which can recover the investment cost of the system in two to five years. This paper treats the history of the refrigeration machine, and the modern developments which have made available the system concept of water heat recovery from refrigeration. A typical application is analyzed from an engineering and economic viewpoint, salient points of both considerations being clearly quantified.

35095 **Energy conservation in process heating systems.** Garmon, N. (Georgia Inst. of Tech., Atlanta). pp 153-181 of Proceedings of third annual energy seminar. Erie, PA; Gannon University (1981).

From 3. annual energy seminar; Erie, PA, USA (31 Mar 1981).

One of the most common operations found in industry today is the utilization of thermal energy to achieve a desired condition such as temperature elevation, melting, drying, curing, phase change, or chemical reaction. Generally, all process heating systems are inherently energy intensive and most are not currently operating in their most energy efficient condition. In times of cheap and plentiful energy sources a small loss of efficiency was of little consequence. Indeed, in most cases it could not be economically justified to accurately track and maintain the performance of energy consuming processes. Now it is imperative that the operation of energy intensive processes be optimized. This report discusses some general approaches for reducing the energy requirements for process heating systems and some specific processes are mentioned. Energy conservation is a renewable resource. The success or failure of many companies will depend on how well its resource is utilized.

## 3206 Municipalities And Community Systems

*REFER ALSO TO CITATION(S) 34303, 34418, 34428, 34482, 34483, 34940, 34941, 34952, 34975, 34981, 34982, 35355*

35096 **(ANL/CNSV-TM—78) Waste-to-Energy Systems Institutional Barriers Assessment Workshop.** (Argonne National Lab., IL (USA); Gershman, Brickner and Bratton, Inc., Washington, DC (USA)). Jun 1981. Contract W-31-109-ENG-38. 57p. NTIS, PC A04/MF A01. Order Number DE82000098.

An outline of the format for conducting the workshop is presented as well as information resulting from the workshop. A list of attendees, discussion groups, and a find list of barriers are included. (MHR)

35097 **(ANL/CNSV-TM—79) Severity of institutional barriers affecting energy-from-municipal-waste technologies.** Dials, G.E.; Greenwood, J.M.; Lewis, L.L.; Cole, E.M. (Argonne National Lab., IL (USA); Los Alamos Technical Associates, Inc., NM (USA)). Jun 1981. Contract W-31-109-ENG-38. 58p. NTIS, PC A04/MF A01. Order Number DE82000133.

The purpose of this study was to assist in identifying institutional impediments to energy from municipal waste (EMW) technologies and analyzing the results from a workshop during which EMW experts were asked to indicate the importance of these barriers. The workshop is summarized. The basic results of the workshop participants' scoring of the institutional barriers according to their importance are described. More elaborate analyses conducted on the workshop results are reported. A summary of the workshop results and a listing of the most important EMW technology/institutional barrier combinations conclude the report.

35098 **(DOE/IR/05106—T47) Evaluation of landfill gas as an energy source. Management report.** (Chicago, City of, IL (USA); Century Engineering, Inc., Towson, MD (USA); Public Technology, Inc., Washington, DC (USA)). Dec 1980. Contract FG02-78IR05106. 45p. NTIS, PC A03/MF A01. Order Number DE82000116.

The benefits and problems associated with landfill gas recovery were considered by the City of Baltimore, resulting in the structuring and testing of a realistic gas recovery evaluation procedure for use by local governments. This Management Report summarizes the Baltimore methodology and presents results of its application to a large landfill in the Baltimore area. Chapter 2 summarizes the landfill gas generation process, potential uses for the recovered gas, and treatment requirements. Chapter 3 presents the methodology developed during the course of the project. Chapter 4 presents results of the application of the methodology to two of Baltimore's landfills. Chapter 5 discusses lessons learned during the Baltimore project presented as a set of guidelines to assist other local governments in their applications of the methodology. Appendix A lists sources for obtaining the original Baltimore Project Report and additional energy management information. (MCW)

35099 **Heat pump systems for district heating and cooling.** Calm, J.M. (Argonne National Lab., IL). *Ground Water Heat Pump Journal ;* 1: No. 4, 16-21(Win 1980).

Centralized, distributed, and cascaded heat pump-centered integrated community energy systems (HP-ICES) are described. Advantages of the community-scale application over conventional and single-building systems are discussed, including response to demand variations, thermal storage, reliability, and the economy of scale. Preliminary results of the System Development phase of the Department of Energy's HP-ICES Project are tabulated. Fuel and energy resource consumption for conventional and HP-ICES systems are graphically compared. Advantages of municipal over private operation, and the need for rights-of-way and waste heat supplies are discussed. (LEW)

## 3209 Education And Public Relations

*REFER ALSO TO CITATION(S) 34964*

# 33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

35100 **(UCRL—85654) Comparison of energy-storage devices for use in future automobiles.** O'Connell, L.G. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 20 Jun 1981. Contract W-7405-ENG-48. 11p. (CONF-811101—6). NTIS, PC A02/MF A01. Order Number DE81026530.

From Winter annual meeting of the ASME Technology and Society Division; Washington, DC, USA (15 Nov 1981).

The Transportation System Research Program of the Lawrence Livermore National Laboratory (LLNL) conducted a study over a four year period to determine which energy-storage devices and their associated propulsion systems are likely to be capable of providing credible alternatives to current type automotive propulsion systems between now and the year 2000. It was found that a complete spectrum of automotive performance levels can be achieved by energy storage automobiles during this time period. These range from automobiles with general-purpose performance equivalent to internal combustion engine (ICE) performance to performance suitable for vehicles with specific missions. These automobiles will likely be more expensive to purchase than their ICE counterparts. Large scale introduction of such vehicles can be constrained not only by the development of energy storage technology, but also by the abailability of the required manufacturing capability and service infrastructure.

## 3301 Internal Combustion Engines

*REFER ALSO TO CITATION(S) 34467, 35117, 35118, 35119, 35120, 35121, 35122, 35126, 35127, 35129, 35131, 35134, 35135, 35136, 35137, 35138, 35139, 35139, 35140, 35141, 35142, 35143, 35144, 35149, 35151, 35152, 35153, 35154, 35155, 35156, 35157, 35159, 35160, 35161, 35162, 35163, 35164, 35165, 35166, 35167, 35178*

35101 (CONF-801030—(Vol.1), pp 265-272) **Cold start driveability emissions, and fuel economy of a stratified charge engine vehicle using methanol.** Johnson, R.T. (Univ. of Missouri, Rolla); Schlueter, D.J. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

An experimental study was performed to evaluate the driveability, emissions, and fuel economy of a spark ignited, prechamber type, stratified charge engine vehicle utilizing methanol as the fuel in the main chamber system. The objectives of the program were to evaluate this engine as a possible mechanism for improving cold starting and driveability with methanol fuel, and, to evaluate the emissions and fuel economy of the system when fueled with methanol. For this series of tests the prechamber fuel used was gasoline and the main chamber fuel was methanol. The gasoline provided the needed volatility in the prechamber system where ignition occurs and the torch-like flame from the prechamber improved the cold starting and driveability characteristics for the main chamber system. Preliminary studies with this system indicated that unassisted starting at temperatures below -1°C was possible. Warmed up driveability was good even though cold start driveability was poor. After preliminary evaluations an air preheater system was installed to aid in solving some of the cold start driveaway problems. Emissions and fuel economy tests using the US EPA Urban Driving Schedule indicated slight increases in the unburned fuel and Carbon Monoxide emissions and a 70% reduction in Oxides of Nitrogen over the gasoline powered vehicle. Energy fuel economy was essentially unchanged between the methanol and gasoline fuel systems. Conclusions from this program are that the prechamber engine system using a vaporized or volatile fuel in the prechamber has promise in improving the cold starting and driveability problems associated with alcohol fuels. Substantial effort will be required to approach the cold start driveability of the gasoline fueled vehicle. The use of methanol fuel in this engine system can reduce Oxides of Nitrogen emissions by a factor of three.

35102 (CONF-801030—(Vol.1), pp 357-360) **Efficient burning of concentrated gasohol of variable composition in spark ignition engines.** Luengo, C.A. (Instituto de Fisica, Campinas, Brazil); Calandra, F.; Piereck, E.; Leshner, M.D. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Electronic combustion control (ECC) may help to solve the problem of efficient burning of concentrated gasohol blends of variable composition in current spark ignition engines. In this work, the results of both road and bench dynamometer testing of ECC equipped units are presented and discussed. The ECC prototype used in these tests has been described in a recent paper.

35103 (CONF-801030—(Vol.1), pp 361-372) **Aspects of the design, development and production of ethanol powered passenger car engines.** Pinto, F.B.P. (Ford Brasil, Sao Paulo, Brazil). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The availability in Brazil of fuel grade ethanol led to the design and development of alcohol powered vehicles. The design approach to conversion of existing gasoline engines, the test program and the resolution of the problems detected during the development phase are described. Material changes implemented to make the engine and vehicle reliability and durability comparable to the current gasoline car are also described. Results of materials and fuel additive testing on a circulation stand are presented. Test results on 1.6L engine alcohol powered vehicles showed the fuel economy to be 83% of the gasoline version while 0-96KPH acceleration showed no deterioration. Powertrain matching and engine downsizing for optimum fuel economy at the same performance level of the gasoline car is addressed.

35104 (CONF-801030—(Vol.1), pp 379-383) **Retrofittable alcohol/petrol carburation system.** van der Weide, J.; Ramackers, M. (TNO, Delft, Netherlands). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The work in the TNO Organization concentrates on the development of retrofittable hardware to enable cars to run on alcohol fuels as well as petrol from the same tank in all mixture ratios. Essential in this approach is a transducer which determines the alcohol/petrol ratio between 0 and 100%. Research and develoment work with respect to different types of transducers is described. Additionally an integrated system of transducer, fuel warm up, electronic circuitry and servomotor for carburetor adjustment is described.

35105 (CONF-801030—(Vol.1), pp 387-395) **Methanol and ethanol as gas turbine fuels.** Bardon, M.F. (Royal Military Coll. of Canada, Kingston, Ontario). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A parametric cycle study was conducted to compare methanol, ethanol, and kerosene as gas turbine fuels. Using realistic current values of component efficiencies and two different maximum turbine inlet temperatures corresponding to high performance and moderate performance engines, cycle efficiency and work output per unit mass of air-flow were determined as functions of pressure ratio for conventional and regenerated gas turbines. It was shown that improvements in cycle efficiency and specific work are possible by using alcohol fuels in place of kerosene but that optimum pressure ratios and gas flow rates are different; therefore, for best performance it will be necessary to design specifically for alcohol rather than using engines designed for hydrocarbon fuels.

35106 (CONF-801030—(Vol.2), pp 613-618) **Results of MAN-FM diesel engines operating on straight alcohol fuels.** Neitz, A.; Chmela, F. (Maschinenfabrik Augsburg-Nuernberg AG, Germany). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Alcohol fuels substitution in diesel engines is described using the MAN-FM combustion system. The advantages for using this system are described. The major features of the MAN-FM methanol engine are: use of straight methanol without any additives or secondary fuel; very low energy consumption; absolute absence of exhaust smoke; possibility of increasing output compared to Diesel engine; unproblematic cold starting; market reduction in NO/sub x/ emissions compared to Diesel engine; and emisson standards imposed for California until 1982 can be met if a catalytic system is used. Recently, operating experience has also been accumulated with ethanol which has revealed just as good results as with methanol. These results have characterized the MAN-FM engine as an economic prime mover which can also be used to operate on alternative alcohol fuel in a beneficial manner. (DMC)

35107 **(DOE/CS/51212—T12) Hydrogen engine performance analysis project. First quarterly report, second year of program, March 1978.** Adt, R.R. Jr.; Swain, M.R.; Pappas, J.M. (Miami Univ., Coral Gables, FL (USA)). Mar 1978. Contract AC03-77CS51212. 10p. NTIS, PC A02/MF A01. Order Number DE81029965.

Objective is to obtain the design data-base covering performance, operational and emissions characteristics of prototype hydrogen-fueled, air-breathing engines for automotive use. Hydrogen-fueled internal combustion engines were divided into fourteen subgroups, and an engine representative of each subgroup will be tested. The Project Program Plan calls for investigation of preintake valve closing fuel ingestion (Pre IVC) hydrogen-fueled engines during the first two years. The following second-year activities have been completed: (1) construction of the 12 to 1 compression ratio engine; (2) construction of the intake manifold for the engine configuration No. 10 (Discontinuity Engine); and (3) construction of the ignition system for engine configuration No. 10. Progress has been made in the following areas: (1) construction of the cylinder head for engine configurations No. 7, 8 and 9; (2) construction of the circuitry for the digital oscilloscope; (3) compilation and initial analysis of literature regarding NO/sub x/ reducing catalysts; (4) design of the high-pressure hydrogen-fuel delivery system; and (5) selection of the single-cylinder Toyota engine configuration and initial contacts with companies who construct such engines.

## 3303 Electric-powered Systems

*REFER ALSO TO CITATION(S) 35100*

35108 **(BNL—51312) Method for estimating technological penetration rates in commercial automobile fleets.** Wagner, J.R. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Nov 1980. Contract AC02-76CH00016. 84p. NTIS, PC A05/MF A01. Order Number DE82000433.

A technique for estimating market penetration rates of electric and hybrid cars in commercial (including police and nonfederal government) fleets is described. The approach is also applicable to other vehicle technologies in the fleet market. It employs survey data collected from 142 fleet operators in March 1979. The data describe physical and economic criteria used by fleet operators to select vehicles. This information, together with a variety of derived relationships and constants, provides the basis for a computer simulation model called CPEN (Fleet Car Market Penetration Simulator). The CPEN user provides data describing the physical and economic attributes of hypothetical vehicles. CPEN then produces market penetration estimates, based on the physical capabilities, purchase prices, and discounted life-cycle costs of alternative vehicles.

35109 **(DOE/CS/51180—T10) Cost of lightweight materials in advanced-technology electric cars.** Curtis, R.L. (General Research Corp., Santa Barbara, CA (USA)). May 1979. Contract AC03-76CS51180. 25p. NTIS, PC A02/MF A01. Order Number DE81024173.

The cost estimates made for the electric cars in the preceding phases of this study assumed that the manufacturing cost per pound of the structural components was the same for all vehicles regardless of the technology level. Since the cost per unit weight of lightweight materials can be appreciably higher than that of the conventional materials they replace, the cost estimates for the vehicles using the advanced technology were low. Accordingly, an estimate was made in this Phase III study of the increased cost of the lightweight materials that are used for the advanced technology vehicles. These new costs are incorporated in the electric vehicle weight and cost model (EVWAC) developed in this study phase. The object of this report is to describe and document the lightweight material cost estimates. The lightweight material for the advanced technology structural applications, based primarily on the substitution of aluminum and/or plastics for conventional material (e.g., mild steel) is estimated to reduce component weight by 55%, with lightweight material costing, per unit weight, 3.4 times as much to manufacture as conventional material. Lightweight material at this weight and cost can be cost-effectively substituted for upper body and chassis structural components made of conventional materials. However, manufacturing cost ratios greater than 3.4 result in higher initial and life-cycle costs for the advanced four-passenger eV investigated. For this average weight savings and cost ratio, the initial and life-cycle costs are independent of the amount of lightweight material substituted.

35110 **(DOE/ET/12437—T1) Fuel cells in vehicular transportation markets. Interim report No. 1: energy savings from using fuel cells in transportation initial assessment.** Nelson, S.H. (Energy Systems Research Group, Inc., Albany, NY (USA)). Jun 1978. Contract AC03-78ET12437. 44p. NTIS, PC A03/MF A01. Order Number DE81026711.

Results of a study on energy savings by market are presented including marine applications, railroads, and highway vehicles (automobiles, buses, trucks, and forklift trucks). Potential fuels are discussed including fuel characteristics and availability and fuel prices and price projections. (WHK)

35111 **(DOE/ET/12437—T3) Fuel cells in vehicular transportation markets. Interim report No. 2: preliminary assessment of vehicular fuel cells.** Nelson, S.H. (Energy Systems Research Group, Inc., Boston, MA (USA)). Aug 1978. Contract AC03-78ET12437. 31p. NTIS, PC A03/MF A01. Order Number DE81026712.

Preliminary market assessments for fuel cells in the marine, locomotive, and highway transportation markets are discussed. Fuel prices are projected for 1990 to 2005, and state motor fuel taxes for the states are tabulated. The DC motor cost factor is discussed. (WHK)

35112 **(DOE/NASA/51044—21) Results of the ETV-1 breadboard tests under steady-state and transient conditions.** Sargent, N.B.; Dustin, M.O. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1981. Contract AI01-77CS51044. 18p. (NASA-TM—82667; CONF-811010—5). NTIS, PC A02/MF A01. Order Number DE81030665.

From 6. electric vehicle council symposium; Baltimore, MD, USA (21 Oct 1981).

Test results are presented of a breadboard version of the ETV-1 electric vehicle propulsion system built by General Electric Company under contract to NASA-LeRC as a part of the Department of Energy (DOE) Electric and Hybrid Vehicle Program. The breadboard was installed in the NASA-LeRC Road Load Simulator facility and tested under steady state and transient conditions. Steady state tests were run to characterize the system and component efficiencies over the complete speed-torque capabilities of the propulsion system in both motoring and regenerative modes of operation. The steady state data were obtained using a battery simulator to separate the effects on efficiency caused by changing battery state-of-charge and component temperature. Transient tests were performed to determine the energy profiles of the propulsion system operating over the SAE J227 a driving schedules.

35113 **(EPRI-EA—1961, pp 7.1-7.29) Assessing the potential demand for electric cars.** Beggs, S. (Charles River Associates, Cambridge, MA); Cardell, S.; Hausman, J. Aug 1981. NTIS, PC A15/MF A01. Order Number DE81904228.

From Workshop on the choice and utilization of energy-using durables; Boston, MA, USA (1 Nov 1979).

Survey data on electric car demand gathered by the National Opinion Research Corporation for Arthur D. Little (ADL) were utilized. Each survey respondent was asked to rank order 16 car designs which differed over nine attributes. Seating capacity, maximum speed, purchase price, and operating costs are all attributes whose valuations can be observed in existing market data. However, the most important attribute which distinguishes electric cars is their limited daily range. It was felt that only survey data allowed for proper treatment of this attribute. Thus, an ordered logit model was developed for the survey data which allows for use of ranked preference data. It differs from the usual logit model of qualitative choice which considers only the most preferred alternative. The ordered logit model is estimated over approximately 200 people in the sample. The main empirical finding is that consumers place an extremely high negative valuation on the limited range. Thus, the results cast considerable doubt on the possibility of much consumer demand for electric cars, given the existing technology.

35114 **(LBL—13109) Future trends in advanced batteries for automobile propulsion.** Cairns, E.J. (Lawrence Berkeley Lab., CA (USA)). Oct 1980. Contract W-7405-ENG-48. 6p. (CONF-8010217—1). NTIS, PC A02/MF A01. Order Number DE81030543.

From International symposium on electrochemistry in industry: new directions; Cleveland, OH, USA (20 Oct 1980).

The possible market for vehicle propulsion batteries is discussed, and the performance goals for a marketable electric vehicle are outlined. Some advanced batteries that have the best chance of finding application in electric automobiles are mentioned. (WHK)

35115 **(ORNL/TM—7904) Electric car: is it still the vehicle of the future.** Graves, R.L.; West, C.D.; Fox, E.C. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 29p. NTIS, PC A03/MF A01. Order Number DE81030437.

An analysis of electric and internal combustion engine (ICE) cars of equivalent performance shows that, even with advanced batteries, the electic vehicle would be much more costly to run (23 cents/mile vs 16 cents/mile) than the ICE car. The electric vehicle, of course, would not use gasoline, thus reducing the nation's dependence on imported oil; however, the cost of oil saved in this way would be about $190/bbl, and the same result could be achieved at about one-quarter the cost by manufacturing synfuels from domestic coal or oil shale. A similar analysis of some proposed hybrid electric vehicles indicates that they are also more costly to operate than an equivalent conventional vehicle, although by a smaller margin (25 cents/mile vs 21 cents/mile). The cost of oil saved by the use of hybrid vehicles is also lower ($95/bbl), although it is still much more than the projected cost of synthetic fuels. The key to improving the economics of the electric vehicle is to increase battery life or lower battery costs.

## 3304 Hybrid Systems

*REFER ALSO TO CITATION(S) 35100, 35108, 35115*

## 3305 Flywheel Propulsion

*REFER ALSO TO CITATION(S) 35100*

## 3306 Vehicle Design Factors

*REFER ALSO TO CITATION(S) 35109*

## 3307 Emission Control

*REFER ALSO TO CITATION(S) 35121, 35361*

35116 (CONF-801030—(Vol.1), pp 275-283) **Operation of a catalytic methanol decomposition reactor for vehicular use.** Voecks, G.E.; Dawson, S.; Houseman, J. (California Inst. of Tech., Pasadena). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A stainless steel reactor has been constructed for on-board vehicle methanol decomposition. The shell-and-tube design appears to operate best in a two pass, counter-flow (methanol/exhaust gas) mode. Although the platinum/alumina catalyst is active in promoting the decomposition of methanol, the catalytic activity for promoting methanol dehydration to form dimethyl ether reduces the hydrogen production. The catalyst is sturdy and has maintained structural integrity throughout the three month test period. Low temperature methanol introduction, which could have caused methanol condensation on the support, did not cause spalling or crumbling. Other catalyst candidates such as the copper/zinc low temperature shift-type catalysts are more selective toward enhancing the methanol decomposition with less activity for methane formation. The effect of higher temperatures at the methanol inlet appears to favor methanol decomposition over dehydration to dimethyl ether which thereby reduces the need for high temperatures at the exit to decompose (steam reform) dimethyl ether. However, at leaner (and more efficient) engine operation, the exhaust temperature is reduced. Therefore, selective catalyst activity which enhances hydrogen and carbon monoxide production may require a composite catalyst bed, i.e., more than one catalyst, positioned in a reactor to match catalyst activity with reactor heat transfer and engine exhaust gas temperature. Alternate reactor designs, on the other hand should offer enhanced heat transfer and improve catalyst activity. While many options exist for both reactor design and catalyst selection, engine operation and vehicular performance will provide the next iteration of data to direct the next step in this research.

## 3308 Alternative Fuels

*REFER ALSO TO CITATION(S) 34417, 34462, 34463, 34465, 34466, 34467, 34492, 34500, 34507, 34512, 34513, 34515, 35100, 35101, 35102, 35103, 35104, 35105, 35106, 35107, 35116, 35361*

35117 **(CONF-801030—(Vol.1)) IV international symposium on alcohol fuels technology.** (Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil)). 1980. 483p. (In English and Portuguese). NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

This book contains the papers from the IV International Symposium on Alcohol Fuels Technology, held at Guaruja, Sao Paulo, Brazil, on October 5-8, 1980. This Symposium is the fourth of its kind, and congregates specialists from several countries working on alcohol and biomass fuels research. This Symposium covers three main areas regarding the alcohol and biomass fuels: production and distribution, utilization, and socio-economical impacts. Separate abstracts have been prepared for each item for inclusion in the Energy Data Base. (DMC)

35118 (CONF-801030—(Vol.1), pp 215-224) **Development of carburetor systems for the use of alcohol in spark ignition engines.** Galvin, M.; Kemp, R.M.; Dryer, F.L. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

To increase the rate at which an alcohol-based fuel could be introduced into New Zealand, it is necessary to consider means by which existing spark-ignition, gasoline-fuelled vehicles can be retrospectively equipped to run on the alternative fuel. The low fleet turnover rate and the complexity of make and model line-up provide an incentive to retain original equipment inlet and exhaust manifold systems. Under a contract from the New Zealand Liquid Fuels Trust Board, a carburetor system has been developed which will enable a wide variety of vehicles to operate satisfactorily on alcohol-based fuels without replacement or modification of manifolds. Details of the conversion system and its calibration for particular vehicles are discussed, together with results of dynamometer and vehicle running. Using a blend of 85% methanol with 15% gasoline, equivalent driveability and performance to gasoline fuel can be obtained with satisfactory cold starting, while fuel economy in energy terms is substantially improved without increasing compression ratio. Alternative methods of cold starting allow satisfactory performance on 100% methanol or azeotropic ethanol with minor adjustments to the system. Mixture conditioning is by recirculation of substantial quantities of exhaust gas heat at controlled temperature, with modulation of heat input according to the power level and speed of the engine. For a substantial part of the engine operating regime vaporized fuel is supplied at the inlet manifold riser with reduction in heat input at high power levels to avoid the possibility of pre-ignition.

35119 (CONF-801030—(Vol.1), pp 225-231) **Oxygen sensor equipped engine operation on methanol/gasoline blends and phase separation problems.** Last, A.J.; Lawson, A.; Simmons, E.W.; Mackay, D.; Tsang, M.; Maund, G.B. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A study was made to address problems related to Canadian utilization of methanol/gasoline blends. These problems are: (1) cold weather operation; (2) water sensitivity to phase separation in winter; (3) vehicle compatibility: fuel/air ratio control, flexibility for vehicle movement outside of areas where methanol might be available. Specifically, the operation of the HydroShear (an in-line hydraulic emulsifier) on the two separated phases of a methanol/gasoline/water blend was examined. Fuel maps, by engine dynamometer testing, were generated using methanol/gasoline blends containing 15% to 65% methanol. The capability of an oxygen sensor, located in the exhaust system, to control the fuel/air ratio was found to be adequate within the 15% to 65% methanol/gasoline blends. A fuel injected Volvo 244DL with λ-sond emission control and a carburetted Chevrolet Monza with 3-way catalyst closed loop feedback emission control system were the two engines selected for this study.

35120 (CONF-801030—(Vol.1), pp 243-246) **Performance and emissions from a turbocharged methanol fueled SI engine.** Nebolon, J.F.; Pessagno, S.L.; Browning, L.H. (Univ. of Santa Clara, CA). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Steady-state engine dynamometer test results from a turbocharged SI engine, run on both Indolene and methanol, are presented in this paper. The discussion focuses on mixture distribution to the cylinders, cold starting and warm-up operation, emissions (including aldehydes), and performance. At all loads and speeds the turbocharger effectively nebulized the fuel, resulting in even distribution of the air-fuel mixture to the individual cylinders. Methanol's high octane rating and mixture charge density contribute to high power output, while its characteristically low NO/sub x/ emissions allow this power to be used where emissions are regulated by law.

35121 (CONF-801030—(Vol.1), pp 247-253) **Feedback controlled fuel injection system can accommodate any alcohol-gasoline blend.** Pefley, R.K.; Pullman, J.B.; Suga, T.P.; Espinola, S. (Univ. of Santa Clara, CA). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A fuel metering system has been adapted and permits operation on all blends of alcohols and gasoline ranging from pure gaso-

line to pure ethanol and methanol. It is a closed loop electronic feedback controlled fuel injection system (EFI) with exhaust oxygen sensor. The system is used by Toyota Motor Company in their Supra and Cressida models in conjunction with a 3-way catalytic exhaust system. These models meet California exhaust and evaporative emission standards. An unmodified model has been tested on alcohol gasoline blends from pure gasoline to 50% ethanol-50% gasoline and 30% methanol-70% gasoline and found to meet all exhaust and evaporative emissions standards. A Cressida with modified EFI system is currently being tested. It is capable of operating on pure gasoline, pure methanol or ethanol and all intermediate blends. The testing to date shows that the vehicle meets all exhaust emissions standards while operating over the blend range from pure gasoline to pure ethanol while maintaining driveability and energy based fuel economy. The paper will present the total test evidence for all gasoline-alcohol blends. This will include exhaust and evaporative emissions, fuel economy and driveability as determined in accordance with United States Federal Test Procedures. Additionally, the paper will report experiences accumulated from road operation of the vehicle over a six-month period.

35122 (CONF-801030—(Vol.1), pp 255-263) **Some studies on the use of methanol-gasoline blends in Indian automobiles.** Pundir, B.P.; Singh, A.K.; Abraham, M. (Indian Inst. of Petroleum, Dehra Dun, India). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The performance of methanol-gasoline blends in unmodified engines/vehicles depends upon the initial carburation and ignition characteristics, fuel system layout and other engine design features. On an automotive engine, the carburation and ignition advance settings were optimized for gasoline and 10 and 20% methanol blends. Results showed that best power and best fuel economy with blends are obtained at an equivalence ratio leaner than that of gasoline. With the optimized carburation and ignition, data on engine power, fuel consumption, efficiency and engine emissions were obtained. The vapor lock performance of the blends on two cars was studied and the ambient temperatures at which blends are expected to give vapor lock were determined. A good correlation between Front End Volatility Index (FEVI) and the critical ambient temperatures indicated the suitability of FEVI as a measure of vapor locking tendency of the blends.

35123 (CONF-801030—(Vol.1), pp 285-288) **Development and testing of an anti-corrosive additive for alcohol fuels.** Codling, V.J. (Promax Produtos Maximos, Sao Paulo, Brazil). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Most common metals such as steel, zinc, zinc alloys, aluminum and copper alloys are more susceptible to hydrated ethanol corrosion than gasoline, kerosene or diesel fuel. Storage tanks, pipelines, transfer pumps, delivery trucks, service station tanks and equipment presently used for petroleum fuels as well as vital parts of converted gasoline or diesel engines, would be subjected to a high rate of corrosive destruction without either surface treatment or substitution of the more critical parts. This could be difficult, costly and time-consuming. As it seems impossible at present to distill a non-corrosive hydrated ethanol fuel, the use of an anticorrosive additive is imperative. Laboratory research and practical tests have shown that a highly concentrated anti-corrosion additive can render an alcohol fuel no more corrosive than standard gasoline or diesel fuel. For best results the additive should be added to the alcohol as soon after production as practicably possible. The additive under study has been in practical use for over a year, is being successfully used regularly in thousands of vehicles and has become a factory fill item by more than one engine manufacturer in Brazil.

35124 (CONF-801030—(Vol.1), pp 299-311) **Fuel systems for alcohols: corrosion and allied problems.** Leng, I.J. (Univ. of Cape Town, South Africa). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Observations on this subject recorded in the literature are summarized and compared with results obtained by the Energy Research Institute in their own tests and trials. Some apparent contradictions are highlighted and discussed, leading to conclusions that: (a) the problems, where they exist can be resolved by correct design and the exercise of a few elementary precautions; (b) conventional engineering metals are generally satisfactory for containing alcohol provided they are used with discretion, though there are a few exceptions; (c) impurities in alcohols, e.g., water and water-borne electrolytes are not necessarily the prime cause of corrosion as has often been supposed. Electrolytic corrosion develops even when the fuel is nominally pure and anhydrous (this is particularly true of methanol); and (d) non-metals are available (plastics, elastomers, etc.) which have good resistance to alcohol attack. Recommendations are included on materials, selection and usage.

35125 (CONF-801030—(Vol.1), pp 319-324) **Methanol-gasoline blended fuels in West Germany: specification and early field experience.** Nierhauve, B. (Aral Research Centre, Bochum, West Germany). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

In the Federal Republic of Germany and West Berlin a large-scale field test initiated by the Federal Ministry of Research and Technology is being carried out during the period from 1979 to 1982, demonstrating the practicability of methanol/gasoline blended M 15 fuel from production in the refinery to utilization in the vehicle. In preliminary tests, it has been evaluated among other topics which kind of modifications of the base fuel would make the application of a fuel blend containing 15% methanol by volume feasible. Test results show that methanol-inherent problems can be solved by various aiming measures. Since large scale commercial use of M 15, however, is not only depending on technical applicability but also on other criteria, only a few of the measures evaluated could be accounted for in the production of the M 15 fuel for field testing. Experience so far did not show serious problems, neither in the distribution system nor in vehicles adapted to this fuel.

35126 (CONF-801030—(Vol.1), pp 325-330) **Specifications of alcohol motor fuels.** Svahn, L.G.G. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

In the plans made for the introduction of alcohol-based motor fuels in Sweden, three different areas of use have been envisaged: (1) alcohol/gasoline blends; (2) straight methanol for spark-ignition engines; and (3) straight methanol for compression-ignition engines. This paper will deal only with the fuels - blends and straight methanol - for spark-ignition engines and is concerned in the first instance with the blend fuels, since these will be the first to be introduced. With regard to fuel specifications, they also pose a more intricate problem than does straight methanol.

35127 (CONF-801030—(Vol.1), pp 341-346) **Ignition timing influence upon piston performance of ethanol fueled Otto cycle engines.** Filho, J.D.E.; Azevedo, M.N.D.; Mahrus, D. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

It is shown that abnormal combustion of ethanol/air mixtures can cause considerable damage to pistons in comparatively short time. Data collected on piston temperature and combustion pressure support findings that under abnormal combustion conditions thermal and mechanical loading of the piston are increased.

35128 (CONF-801030—(Vol.1), pp 347-352) **Technical and economical aspects of ethanol as an automotive fuel for Turkey.** Guelder, O.L. (Middle East Technical Univ., Ankara, Turkey). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

In this work, first, a brief discussion on Turkey's situation and possible adoption of an alcohol fuel scenario is given. Then, re-

sults of experiments conducted on a four-cylinder passenger car spark ignition engine are reported. Engine performance tests were conducted at simulated road load conditions using neat ethanol and blends of ethanol-gasoline and ethanol-water as fuels. Addition of anhydrous ethanol to regular gasoline improved the Octane number. But, presence of ethanol in gasoline up to 25% by volume did not produce any noticeable change in engine thermal efficiency. With neat ethanol, approximately a 3% increase in engine thermal efficiency over gasoline was realized. Ethanol-water blends yielded lower thermal efficiencies as compared to that of gasoline. Water in ethanol improved the knock resistance of the ethanol fuel appreciably. In order to benefit from this advantage of ethanol-water blends, engine compression ratio was increased from 9.2 to 13.5, and substantial improvements in thermal efficiency were observed using ethanol-water blends as fuels.

**35129** (CONF-801030—(Vol.1), pp 373-378) **Development of alcohol powered automobiles at the Volkswagen factory, Brazil, South America.** Schmidt, P.; Czaschke, H.W.; Rangel, G.N.; Pinto, N.L.M. 1980. (In Portuguese). NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

**35130** (CONF-801030—(Vol.1), pp 403-408) **Utilization of ethanol as a fuel in utility size boilers.** Jones, E.C. (Light-Servicos de Electricidade, Sao Paulo, Brazil). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

This paper reports the practical tests and development of feasibility trials for the utilization of ethanol, a previously untried replenishable fuel in large furnaces, as a substitute for the existing petroleum derived fuel oil. A small work group was formed to evaluate alternative fuels and execute load trials on the boilers of a conventional steam power station. The trials proved in a practical manner that ethanol can be used as a fuel for large boilers. The low costs and ease of the conversion to ethanol of an existing fuel oil or gas fired boiler make it a very attractive fuel alternative. Ethanol could be fired together with other fuels in proportions that would bring excessive stack emissions within established pollution control limits not obtainable with the original fuel. It is not expected that ethanol derived from sugar cane will develop as the prime alternative boiler fuel of the future. The overall energy gain in producing ethanol is not sufficient to justify producing it to burn in boilers as a base fuel. There must, however, be many places in the lesser developed areas of the world where the local production of ethanol could be technical, economic or even socially an attractive alternative to the dependency on imported fuel oil for an essential already installed power station.

**35131** (CONF-801030—(Vol.1), pp 423-429) **Eucalyptus experiment.** Takeda, S. (Mie Univ., Tsu, Japan); Uchiyama, H. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The experimental study of the blended fuels under various percentage of mixing of gasoline and alcohol was conducted using a two stroke cycle farm engine and small car operated on a dynamometer and chassis dynamometer respectively.

**35132** (CONF-801030—(Vol.1), pp 431-439) **Effects of biomass fuels on diesel engine combustion performance.** Bacon, D.M.; Bacon, N.; Moncrieff, I.D.; Walker, K.L. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A number of potential alternate biomass derived fuels were tested on a diesel engine. The results of these tests are reported in this article. The results indicate that: (1) Many vegetable oils have a number of characteristics in common and can be considered as possible diesel fuels. In general they require extensive degumming, or preferably blending, to eliminate severe coking problems. As biomass fuels there is considerable merit in searching for an ethanol-vegetable oil emulsion to solve this problem and that of reported lubeoil polymerisation. (2) Ethanol can serve as a satisfactory diesel fuel from a performance aspect provided adequate ignition improvers are used. Smoke and regulated emissions are minimal and efficiency at mean diesel levels is naturally far superior than when used in a spark ignition engine. (3) Cetane number, while an adequate parameter when used with petroleum based hydrocarbon fuels, is not a satisfactory measure of combustion characteristics with alternative fuels. Significant differences in volatility and chemical composition alter the relationship between ignition delay and the degree of pre-mix burning for a given set engine condition. Future work will endeavour to bring this volatility factor into a simplified, but meaningful relationship.

**35133** (CONF-801030—(Vol.1), pp 441-449) **Corrosivity of ethanol fuel mixtures to fuel system materials.** Wiggle, R.R.; Hospadaruk, V.; Styloglou, E.A.; Chui, G.K.; Tallent, W.D.; Fairbanks, S. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The corrosion behavior of automobile fuel system metals was studied in hydrated ethanol contaminated with various amounts of chloride ions, acetic acid, and ethyl acetate. Standard electrochemical techniques were employed, which included potentiodynamic polarizations, measurement of corrosion rates with the linear polarization method and measurement of the open-circuit corrosion potentials. The significance of these electrochemical measurements in relation to longer-term thermal cycle immersion corrosion tests is discussed. These techniques were also used to investigate the relative effectiveness of selected commercial inhibitors in reducing corrosion. A procedure for selecting candidate inhibitor packages for long-term simulated service fuel circulation tests is recommended.

**35134** (CONF-801030—(Vol.1), pp 453-456) **Utilization of pure alcohol fuels in a diesel engine by spark ignition.** Adelman, H.G.; Pefley, R.K. (Univ. of Santa Clara, CA). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Pure methanol and ethanol have been used successfully in a diesel engine by the addition of a spark ignition system. Spark ignition of injected alcohol fuels avoids the necessity of cetane improving additives or engine modifications such as higher compression ratios or intake air preheating which may increase exhaust emissions or decrease thermal efficiency. In addition, spark ignition may be less complex and expensive than dual fueling with pilot ignition by injected diesel fuel. The thermal efficiency, power and exhaust emissions of a swirl prechamber, single cylinder diesel engine using alcohol fuels with spark ignition are compared to normal diesel fuel operation. Thermal efficiency and power output are about the same with the alcohols. In addition, the alcohols produce lower NO/sub x/ emissions and no particulates. Any particulates which are formed with alcohol fuels will be due to lubricating oil which reaches the combustion chamber. While unburned fuel emissions are higher for the alcohols, diesel fuel values do not include particulates formed from unburned fuel. Further development of this type of spark ignited engine should lead to lower unburned fuel and carbon monoxide emissions and an extension of the lean operation limit which is currently characterized by occasional misfires.

**35135** (CONF-801030—(Vol.1), pp 457-463) **Investigations and results with MWM pilot-ignition ethanol combustion system.** Dietrich, W.; Anisits, F.; Hiemesch, O. (Motoren-Werke Mannheim, Germany). 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

This paper reports on research work at MWM (Motoren-Werke Mannheim), aimed at a design that will allow tractor diesel engines to be converted largely to ethanol working. The basis of these investigations was provided by a pilot-ignition combustion system featuring separate pilot oil and ethanol injection. Exhaustive optimization work has paved the way for the development of a

combustion procedure which is characterized by low fuel consumption, diminished pilot oil injection and high output.

35136 **(CONF-801030—(Vol.2)) IV international symposium on alcohol fuels technology.** (Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil)). 1980. 433p. (In English and Portuguese). NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

This is the second of 2 volumes containing the texts of papers presented at the Symposium. The subject areas include: diesel engines; fleet tests; lubrication and emission; socio-economic aspects; socio-political aspects; socio-agricultural aspects; and projects. Each paper has been indexed separately for inclusion in the Energy Data Base. (DMC)

35137 (CONF-801030—(Vol.2), pp 465-470) **Methanol-diesel engine with minimum pilot injection quantity.** Finsterwalder, G.; Kuepper, H. (Kloeckner-Humboldt-Deutz AG, Cologne, Germany). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The methanol-diesel engine with pilot injection is a method to substitute diesel fuel. To save as much diesel fuel as possible the pilot injection quantity must be kept small. Investigations are described, which lead to minimum pilot injection quantity.

35138 (CONF-801030—(Vol.2), pp 471-475) **Operation of a heavy-duty truck diesel engine on unstabilized methanol/diesel fuel emulsion and preliminary demonstration road test data.** Deshpande, A.S.; Lawson, A.; Last, A.J. (Ontario Research Foundation, Sheridan Park). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The uncertainty regarding supply of conventional petroleum fuels has provided a real opportunity in Canada to employ partial substitution of diesel fuel with alcohol. This paper briefly outlines an ongoing research, development and demonstration project sponsored by the Canadian Federal Government that will yield a practical retrofit diesel/methanol fuelling system compatible with commercial heavy duty diesel engines without major engine modifications. The basic phases of this project discussed are: design of the diesel/methanol emulsion fuelling system for a Detroit Diesel 8V 71N engine; engine dynamometer tests with this system for comparative evaluation of performance, combustion and emission characteristics; retrofit system installation on a GMC Brigadier Truck powered with Detroit Diesel 8V 71N Engine; and Preliminary Demonstration Road Tests to determine fuel consumption and performance.

35139 (CONF-801030—(Vol.2), pp 477-483) **Performance and aldehyde emissions of a surface ignition alcohol engine and comparison with spark ignition engines.** Badami, M.G.; Ayyaswamy, R.; Nagalingam, B.; Ganesan, V.; Gopalakrishnan, K.V.; Murthy, B.S. (Indian Inst. of Tech., Madras). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A summary of the work done on alcohol engines at Indian Institute of Technology, Madras, is presented. A vehicle diesel engine was modified for diesel oil-alcohol operation. Dynamometer tests were conducted to identify an optimal tailoring of the alcohol flow rate. Road tests revealed a substantial substitution of diesel fuel. The construction and performance of a Surface Ignition Engine using alcohol are explained. The exhaust aldehyde emissions of a Spark Ignition alcohol engine have been studied and compared. A new stratified charge engine under development is also mentioned.

35140 (CONF-801030—(Vol.2), pp 485-491) **Use of a spark plug for the operating of a multi-fueled diesel engine.** Nanni, H.; Domschke, A.G.; Brunetti, F.; Rozov, V.; Rosa, F.; de O. Borba, M.L.; de Abreu, R.S. (Instituto Maua de Tecnologia, Sao Caetano do Sul, Brasil). 1980. (In Portuguese). NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

35141 (CONF-801030—(Vol.2), pp 493-501) **Experiments with alcohol/diesel fuel blends in compression-ignition engines.** Moses, C.A.; Ryan, T.W.; Likos, W.E. (Southwest Research Inst., San Antonio, TX). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Microemulsions of methanol and of ethanol in diesel fuel have been successfully formulated and studied in a CLR single-cylinder diesel engine to evaluate their potential of extending diesel fuel supplies. Alcohol concentrations were from 10 to 30%. Solutions of anhydrous ethanol in diesel fuel were also included in the study to see if the emulsion structure played a role in the atomization/combustion process. Data on diesel-fuel savings and relative cost are presented. Effects on thermal efficiency are discussed.

35142 (CONF-801030—(Vol.2), pp 503-506) **Simultaneous use of diesel fuel and alcohol in one-cylinder engines using direct injection.** Silverio, J.A. (Ministerio da Industria e do Comercio, Brazil). 1980. (In Portuguese). NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

35143 (CONF-801030—(Vol.2), pp 507-511) **Fuel system for dual-fuel operation of an automotive diesel.** Singh, A.K.; Pundir, B.P.; Singh, A. (Indian Inst. of Petroleum, Dehra Dun). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A fuel system to induct alcohols in the inlet manifold of an automotive diesel engine was designed. To avoid a poor part load performance, the system was designed to make alcohol induction only above certain predecided loads. Maximum rate of alcohol induction can be varied as desired. Performance of a 6-cyl diesel engine with methanol induction above 50% loads and in quantities up to 25% was studied.

35144 (CONF-801030—(Vol.2), pp 513-520) **Utilization of alcohol as a fuel in diesel engines.** Sugiyama, H. 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

An investigation into the maximum practical use of alcohol with minimum modification in conventional diesel engines has been conducted. Two major approaches have been studied; ethanol/diesel fuel blend and forced ignition by pilot injection of diesel fuel. The diesel engines with three different chambers were used; prechamber, swirl chamber and open chamber. In using blended fuel it is shown that increased ethanol percentage results in increased HC emission and decreased thermal efficiency especially at low load. In order to study the optimization of the combustion chamber design for dual fuel injection engine, incylinder Schlieren observation was conducted using a swirl chamber head with quartz windows. A series of engines with this optimized chamber design currently under study is achieving a good efficiency and low pollutant emissions. For small percentage substitutions it is estimated that the use of alcohol/diesel fuel blend would be feasible. For large percentage substitutions dual fuel injection system is a promising technology although alcohol fuel prices and material developments remain as obstacles.

35145 (CONF-801030—(Vol.2), pp 523-531) **M-15 blend test programme of the New Zealand Liquid Fuels Trust Board.** Duncan, J.; Titchener, A.L. 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The Liquid Fuels Trust Board was set up by the New Zealand Government in November 1978 for the prime purpose of seeking means of reducing New Zealand's dependence on imported transport fuels. One possible option is to use methanol, produced from indigenous natural gas, as a petrol extender in a 15 pct blend. The paper outlines the Board's M15 test programme, which includes as major components a series of single vehicle trials and fuel-distribution trials. Other matters under investigation, e.g. toxicity, flammability, materials compatibility, are also reviewed. The results to date are summarized and discussed.

35146 (CONF-801030—(Vol.2), pp 533-540) **Methanol gasoline blends in New Zealand.** Dyer, W.G. 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Since 1977, BP New Zealand Limited has operated a fleet of vehicles, to demonstrate that alcohol gasoline blends were capable of being used in the New Zealand environment. This fleet has now completed in excess of 1.2 million km on the test fuel, with few operational or component incompatibility problems being reported. In addition, determinations of fuel economy, and hot fuel handling characteristics were obtained on the alcohol gasoline blend, to compare the performance of this fuel with conventional gasoline. The fuel evaluation programme has included development of techniques to clean underground tanks in preparation for alcohol gasoline blends, and the evaluation of a large number of distribution and vehicle system components for compatibility with the alcohol blend.

35147 (CONF-801030—(Vol.2), pp 541-542) **Sudan experience in using alcohol as automotive fuel.** Elias, A.R. (Univ. of Khartoum, Sudan). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Since the oil crisis in 1973, research workers were looking into alternative energy sources. By 1982, Sudan will be self-sufficient of sugar and will start exporting sugar to other countries. Adequate amounts of molasses will be available. An estimate of a quarter to half a million metric tons annually of molasses is expected. Investigation started to find out different utilizations for the molasses. One of the possibilities is alcohol production (by molass distillation) for blending with unleaded gasoline for use in motor cars. This work describes the practical experiment carried out on two different vehicles popular in Sudan. Road tests in various parts of the country were done to investigate the performance of the vehicles using the Alcohol Blend. After finishing the tests, engines of vehicles were dismantled so as to check the cylinder head, valves, pistons and spark plugs. In general, the running of the vehicles with the blend was satisfactory with small reduction in fuel consumption but extra carbon deposits in the cylinder head and valves.

35148 (CONF-801030—(Vol.2), pp 543-550) **Utilization of ethanol in Indian cars, scooters, motorcycles and tractors.** Gupta, R.K.; Ahluwalia, J.S. (Indian Oil Corporation, Ltd., Faridabad). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Laboratory and field test programmes were conducted on Indian passenger cars, scooters, motorcycles and three-wheeler taxis to determine the feasibility of using 10% and 20% ethanol-gasoline blends. Trials were also run with ethanol-diesel blends on tractors. Fuel economy and driveability data obtained with blends were compared with that received with neat fuels. Water tolerance and compatibility of nonmetallic fuel system components were also studied with respect to ethanol-gasoline blends. Availability of alcohol and prospects of using ethanol-gasoline blends in India are discussed.

35149 (CONF-801030—(Vol.2), pp 557-562) **Results from basic research on alcohol powered vehicles.** Menrad, H.K.; Loeck, H. (Volkswagenwerk AG, Wolfsburg, Germany). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Some results of the basic work done by Volkswagen Research Division in Germany in the field of alternative fuels are reported in this article. The characteristics of alcohol fuels and blended fuels are discussed. Various tests were performed in order to study the behavior of various fuels in specially tuned engines. Results indicate that: alcohol-gasoline blends permit higher engine efficiencies and lower exhaust gas emissions than in gasoline-fuelded engines; the cylinder-pressure indicating provides information on the advantageous behavior of alcohol fuels; and the economically most favorable overall fuel-engine concept is realized with alcohol fuels that attain the necessary characteristics by the addition of other components with higher volatility.

35150 (CONF-801030—(Vol.2), pp 573-577) **Thailand's experience with hydrated ethyl alcohol: gasoline blended motor fuel.** Vicharangsan, T. (Ministry of Industry, Bangkoky, Thailand). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A plan has been established to mix agro-ethanol in gasoline for use as motor fuel, and a test programme was conducted to determine the practicality of such a blended fuel utilization in Thailand's conditions. A test fleet of 14 gasoline-powered cars operating on alcohol-gasoline blended fuel travelled a total distance of more than 160,000 kilometers in various traffic situations and climatic conditions of that country. Tests were also conducted on motor cycles and gasoline utility engines. Results of these tests were also discussed.

35151 (CONF-801030—(Vol.2), pp 583-589) **Problems in the adaption of ethanol to the specification of diesel engines.** Bandel, W. (Daimler-Benz AG, Stuttgart, Germany); Ventura, L.M. 1980. (In Portuguese). NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

35152 (CONF-801030—(Vol.2), pp 591-593) **Mixtures of alcohol and castor oil as alternative fuels for diesel engines.** Bin, J.V. 1980. (In Portuguese). NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

35153 (CONF-801030—(Vol.2), pp 595-602) **Ethanol blended fuels for diesel engine.** Mori, M. (Yammar Diesel Engine Co., Ltd., Osaka, Japan). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

It is very difficult to use neat alcohol for diesel engine fuel because of low cetane number. In order to challenge this problem, the study of two kinds of fuels blended with alcohol were carried out. The one of them is ethanol-castor oil blend fuel and the other is ethanol-castor oil-gas oil blend fuel. Engine performance is almost the same to that of petroleum, but there occur diesel-knock and misfire. In order to improve this problem, several tests were carried out such as raising up compression ratio, making hot point near the throat of precombustion chamber, adding ignition improver in blended fuel and variation of valve timing.

35154 (CONF-801030—(Vol.2), pp 603-611) **Operation of dual fuel compression ignition engines utilizing diesel and methanol.** Naeser, D.; Bennett, K.F. (Univ. of Cape Town, South Africa). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Laboratory work on the analysis of pressure rise rates and ignition delay on a single cylinder test dual-fuel engine using various methanol/diesel ratios is reported. The tests show that methanol can be used in compression ignition engines as a partial diesel replacement fuel when introduced with the inlet air. Although methanol injection via a second injection nozzle in the cylinder head will give better results with regard to ignition delay and pressure rise rates, the ease of retrofitting of the systems used by the ERI warrant their further development as an interim diesel fuel saving measure. It can be concluded that ignition delays and associated knock can be reduced to a minimum in indirect injection engines when using the evaporative methanol injection system, but that more work still has to be done with regard to cylinder and ring wear. The combustion chamber configuration and size, and associated high turbulence of small precombustion chambered engines is thought to reduce the likelihood of methanol detonation on such engines. The use of vapourized methanol in large direct injection engines may maximize the use of methanol, but problems of further worsened pressure rise rates due to the more rapid combustion of the methanol part of the charge may be expected. It is also possible that detonation of end gases may be worsened due to higher cylinder temperatures. (DMC)

**35155** (CONF-801030—(Vol.2), pp 619-625) **Suitability of different alcohol-fuels for diesel engines by using the direct-injection method.** Pischinger, F.F.; Havenith, C. (Technical Univ., Aachen, Germany). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The direct injection of alcohol combined with a gasoil ignition spray is a good way to substitute a major portion of gasoil with methanol or ethanol. Compared with the conventional diesel engine the emission of gaseous pollutants as well as the combustion noise level are reduced. While maintaining efficiency, the dual fuelling concept also allows the use of alcohol fuels with a high content of water or other impurities. Gasoil as an ignition fuel can also be substituted by a mixture of alcohol and ignition improver without adverse effects on engine characteristics. Compared with the utilization of alcohol-ignition improver mixtures in a standard diesel engine, the dual-fuel operation allows a considerable saving of the expansive ignition improver. Furthermore the mechanical stress of the engine as well as the emission of gaseous pollutants are reduced. The investigations of different pilot fuels also show that vegetable oils are a good alternative to gasoil as ignition spray.

**35156** (CONF-801030—(Vol.2), pp 627-634) **Consumption data and considerations on three approaches to diesel-oil substitution.** Pischinger, G.; Clymans, F.; Fernandes, F. (Volkswagen do Brazil S/A, Sao Paulo). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

In this paper, consumption data will be presented on three approaches to the substitution of Diesel Oil. A Passat vehicle has been modified to run on straight peanut oil in a Diesel engine; also examined is the partial substitution of Diesel oil by vegetable oil; and of the several ways of using ethanol in a Diesel engine, we chose to go the way of adding to the ethanol a cetane-number improver. Volumetric consumption is given in comparison with an ethanol SI Passat modified to give performance similar to that of the Diesel Passat.

**35157** (CONF-801030—(Vol.2), pp 635-639) **Ethanol an alternative fuel for diesel engines.** Starke, K.W. (Basf AG, Ludwigshafen am Rhein, Germany). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

For the use of alcohols as alternative fuels, several technologies are known to be applicable, some of which were proven in tests. The following applications are discussed in this paper: (1) operation of diesel engines with alcohol fuels, the cetane number of which has been improved; (2) dual fuel operation of diesel engines with alcohol and diesel fuel; (3) operation with diesel fuel/alcohol solutions or emulsions; and (4) operation with alcohol by-products.

**35158** (CONF-801030—(Vol.2), pp 641-646) **Ethanol fuels with ignition improver for turbocharged diesel engines.** Fahlander, S.; Walde, N. (SAAB-SCANIA, Soedertaelje, Sweden). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The problems related to the adaption of a highly rated turbocharged diesel engine to a fuel based on ethanol with components for increasing the ignition quality are discussed. The fuel properties and their influence on the combustion process are analyzed based on test bench experiments. Emission data and selected engine parameters are used for this purpose. Preliminary chemical analyses indicate that the exhaust gases are cleaner and probably not more harmful than normal diesel exhaust gases.

**35159** (CONF-801030—(Vol.2), pp 649-656) **Emission and wear characteristics of an alcohol fuelded fleet using feedback carburetion and three-way catalysts.** Baisley, W.H.; Edwards, C.F. (Univ. of Santa Clara, CA). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Alcohols (both ethanol and methanol) have been recognized as alternate fuels to replace dwindling gasoline supplies. In order to assess three-way catalyst performance on alcohol fuels, five 1978 Ford Pintos have been retrofitted to run on neat alcohol fuels. The modification process included carburetor rejetting, upgraded fuel filtration and electric cold start assistance. Over 40,000 vehicle miles have been accumulated during an 18-month period. Driveability, fuel economy and emission histories (CVS-75) have been obtained. Emissions levels were below 1983 United States Federal standards throughout 10,000 miles of operation on neat methanol. Testing after 10,000 miles showed unusual emissions increases. These have been attributed to degradation of internal engine components rather than alcohol-emission control incompatibility. Wear metal samples have been taken at 1000-mile intervals and analyzed for 16 metallic constituents using Direct Reading Emission Spectroscopy (DRES). Percentage fuel and water dilution were also measured. Measurement of internal engine parts at the end of the test period revealed extreme upper cylinder wear. This wear was not prevised by historic iron accumulation rates in the engine lubricant. Based upon all gathered evidence, an assessment of alcohols in three-way catalyst applications has been made.

**35160** (CONF-801030—(Vol.2), pp 657-663) **Analytical study of aldehyde formation during the exhaust stroke of a methanol-fueled SI engine.** Browning, L.H.; Pefley, R.K. (Univ. of Santa Clara, CA). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A one-dimensional fluid mechanics model of the exhaust port and manifold have been combined with detailed chemical kinetics in order to study aldehyde formation during the exhaust event. This model includes instantaneous heat transfer, fluid mixing and detailed methanol oxidation kinetics. Aldehyde formation and emissions are examined in this study for a variety of engine operating conditions. These include air-fuel ratio, compression ratio, spark retard and engine speed. It was found that the effects of various engine operating conditions were primarily governed by average exhaust temperature, oxygen concentration and exhaust system residence times. It was also foud that high NO emissions have a signifcant effect on methanol and aldehyde oxidation rates. Sources of both unburned methanol and aldehyde emissions as well as their fate in the exhaust port and manifold are also discussed in this paper.

**35161** (CONF-801030—(Vol.2), pp 665-674) **Lubrication behavior in ethanol fueled engines.** Chui, G.K. (Ford Motor Co., Dearborn, MI); Baker, R.E. 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

This paper presents engine wear test results with neat ethanol. These results do not apply to ethanol/gasoline blends. The Sequence V-D procedure designed by ASTM to evaluate motor oils with respect to engine wear and cleanliness was modified to accommodate ethanol as the fuel. At the standard operating temperatures, engines using ethanol were essentially free of sludge and varnish, and had wear equal to the baseline and gasoline tests. The severity of the V-D test was increased by lowering the operating temperatures. With the oil controlled at temperatures typical of short-trip driving combined with ambient temperatures below 25° C, wear of many engine components increased substantially using ethanol as the fuel. The lower temperature also increased wear using gasoline, but to a lesser extent. The effect of operating temperature on the lubrication and wear of various engine components is discussed. Impurities in the fuel grade ethanol may affect oil properties, especially at low temperature when more of the fuel is retained in the crankcase. The effects of water and acid content were examined. Several oil formulations were tested in order to isolate the various wear mechanisms. Engine wear and oil properties were monitored by oil analyses. The results of these tests and the implications for vehicles using ethanol fuel are discussed.

35162 (CONF-801030—(Vol.2), pp 675-681) **Some aspects of component wear in alcohol engines.** Fotedar, H.L. (Eaton Corporation do Brasil, Sao Paulo). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Wear in valves, cylinder head seat inserts and valve guides was analyzed after field and dynamometer tests in adapted automotive and stationary alcohol engines. Wear was found to be adhesive and abrasive in nature. A series of measures are suggested to reduce wear in these mating parts with consequent improvement in engine performance and durability.

35163 (CONF-801030—(Vol.2), pp 683-690) **Methanol and formaldehyde kinetics in the exhaust system of a methanol fueled spark ignition engine.** Ito, K.; Yano, T. (Hokkaido Univ., Sapporo, Japan). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A modified chemical kinetic model has been used to explain the mechanism leading to formaldehyde formation in a methanol fueled spark ignition engine. The model scheme includes the reaction $NO + HO_2 = NO_2 + OH$ which becomes important in an exhaust system containing a large amount of nitric oxide under a relatively low temperature ranging 600 to 1000 K. In order to accomplish the scheme and to determine its validity, careful experiments using a heated tube reactor fitted to an engine exhaust port were carried out. The reactor was kept constant in a temperature range of 600 to 900 K and residence time of induced exhaust gases in the reactor was varied. Concentrations of unburned methanol and formaldehyde were measured to compare with computed results. Determination of the initial concentration of unstable species was also discussed. The results indicate a good agreement between the predictions and the experiments of both formaldehyde and unburned methanol profile in reactor tube conditions. Methanol oxidation and formaldehyde reaction depend on the gas temperature and the residence time. At a temperature above about 900 K, methanol oxidation as well as formaldehyde destruction is rapid and complete in the residence time of 40 milliseconds or less. At a temperature below 800 K, methanol is slowly oxidized and formaldehyde is gradually accumulated in a long residence time.

35164 (CONF-801030—(Vol.2), pp 691-700) **Lubrication requirements for alcohol-fueled spark ignition engines.** Owens, E.C.; Marbach, H.W. Jr.; Frame, E.A.; Ryan, T.W. (Southwest Research Inst., San Antonio, TX). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Research into the effects of alcohol on engine lubrication and wear has investigated four alcohol-containing fuels: pure methanol, pure ethanol, methanol in unleaded gasoline, and 10 percent ethanol in unleaded gasoline (gasohol). This research work has found that during low-temperature engine operations such as winter commuter service and warmup, use of pure methanol may result in increased engine wear. This increased wear appears to be primarily a low-temperature problem. With the engine warmed to normal operating temperatures, this increased wear has not been observed. To this point, the research with ethanol and gasohol has not detected any wear increases. This may be due to the short duration engine tests being conducted, but, nevertheless, indicates that increased wear should be of less concern with these fuels. Wear mechanism studies have indicated that corrosive attack within the piston ring and cylinder area by alcohol combustion byproducts is partially responsible for the increased wear. Investigation of alcohol and lubricant compatibility and physical removal of the lubricant films by liquid alcohol have provided additional insights into this wear phenomena. Solutions to this problem are being pursued through development of engine lubricants for use with alcohol fuels. All of this testing has been conducted using engine dynamometers in research laboratories using established test procedures. However, no vehicle testing or correlation to vehicle operations have been conducted.

35165 (CONF-801030—(Vol.2), pp 701-707) **Methanol/ethanol/gasoline blends in stratified charge engine vehicles.** Pefley, R.K. (Univ. of Santa Clara, CA); Adelman, H.G.; Suga, T.; Vann, L.G. Jr.; Wiens, F.J. 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

This test program was established to fully assess the performance and exhaust emissions of vehicles with stratified charge engines operating without carburetor modification on alcohol blends. The tests included measurements of driveability, fuel economy, exhaust emissions, materials compatibility and engine wear for methanol and ethanol blends. The results show that unmodified Honda CVCC vehicles fueled with 5% and 10% methanol and 10% ethanol blends meet all 1978 and 1980 California passenger car exhaust emission standards. However, all of the alcohol blends tested in the unmodified vehicles cause significant increases in evaporative emissions. All of the blends caused minor degradations in fuel economy while a ranking of the driveability showed best operation on gasoline, nearly as good on 5% methanol and 10% ethanol blends, and still quite acceptable on a 10% methanol blend.

35166 (CONF-801030—(Vol.2), pp 709-716) **Lubrication of SI ethanol engines.** Pischinger, G. (Volkswagen do Brazil S/A, Sao Paulo); Clymans, F.; Cardona, W.; Kilby, D.; Bartholomaei, N.T.; Blackman, D. 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

A commercially marketed SE quality motor oil was used in three phases of engine evaluations to determine the ability of the oil to lubricate the VW ethanol engines satisfactorily. The areas of concern involved adequate lubrication against wear, ability to neutralize and disperse alcohol blow-by materials to VW recommended oil-drain limits of 7500 km, and effects of possible fuel dilution on the lubricant including the chemistry of lubricant additives.

35167 (CONF-801030—(Vol.2), pp 725-732) **Brazilian evolution of alcohol on automotive use and its air pollution concerns.** Branco, G.M.; de Toledo, M.P. 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

This paper provides an overall description of the evolution of alcohol use as an automotive fuel in Brazil. A chronological description of engine modifications for both Otto and Diesel cycles is presented. These modifications were carried on by the Centro Tecnico Aeroespacial - CTA, after careful studies with mono and multicylinder engines. Some cars with engines modified under such guidelines and others without any changes were tested by CETESB, in terms of concentration for tailpipe, emissions, using pure alcohol and several alcohol blends with gasoline respectively. The results showed a carbon monoxide reduction and an aldehyde increase, these results are considered as preliminary ones. Prelimi-

nary findings and theoretical expectations in terms of exhaust pipe emissions and their possible role in the air quality trends at Sao Paulo Metropolitan Region are exposed. Diesel smoke regulations under development are discussed. The adaptation for Constant Volume Sampler calculations in the case of alcohol blends and pure alcohol are present for Otto cycle cars, and other necessary normalizations are posed. Present analytical procedures for non usual emissions and further requirements of development are discussed. Advantages and problems of alcohol as automotive fuel for cars are summarized.

35168 (CONF-801030—(Vol.2), pp 781-786) **Scenarios for alcohol fuels.** Dutkiewicz, R.K. (Univ. of Cape Town, South Africa). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The introduction of alternative transport fuels in South Africa is discussed in this paper. For strategic and financial reasons South Africa has to become less reliant on imported transport fuel. There is already a growing oil-from-coal industry based on the Fischer-Tropsch process. Methanol could be a useful fuel produced from coal and gas in parallel to further oil-from-coal expansion. The amount of methanol which could be produced is governed mainly by the economics of new oil-from-coal processes being developed at present. It is not expected that such new processes would be available before the 1990's. It is expected that ethanol will play a minor role and will be mainly regionally based. Experiments are currently under way to demonstrate the acceptability of methanol as a transport fuel on large commercial vehicles up to 300 kW. (DMC)

35169 (CONF-801030—(Vol.2), pp 787-793) **Demonstration and commercialization of alcohol/gasoline blends in the USA.** Ecklund, E.E. (Dept. of Energy, Washington, DC). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Recent activities in the USA have broadened use of oxygenated hydrocarbons, termed alcohols, into commercial use as additives to gasoline. Demonstrations of advanced blend formulations are also being conducted. Activities include use of MTBE and a 1:1 mix of TBA/methanol as octaine blending agents, growing use of Gasohol (a 1:9 mixture of ethanol and unleaded gasoline) and demonstrations of formulated ethanol and methanol based alcohol/gasoline (1:9) blends. Recent federal legislation provides for substantial fiscal support for alcohol production facilities and planning to achieve 10 billion gallons per year alcohol supply by 1990.

35170 (CONF-801030—(Vol.2), pp 839-842) **Description of the Bank of America methanol and methanol/gasoline blend demonstration.** Fisher, M.; McCurdy, G. 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The demonstration program conducted by the Bank of America to determine the practical limits of methanol/gasoline blends and methanol as automotive fuels is described. The objectives of the program are: to reduce the bank's vulnerability to gasoline shortages, to help maintain a healthy business climate, to gather data on the use of methanol, to better understand business opportunities for the bank in the emerging fuel methanol industry. The results indicate that: methanol fuelded cars are proving satisfactory despite early problems; fuel handling and work area procedures have been established; facilities installation and shakedown, after some construction delays, are proceeding satisfactorily, and blend introduction procedures and initial car-blend sensitivity estimates have been performed. (DMC)

35171 (CONF-801030—(Vol.2), pp 843-845) **Alcohol fuels in Portugal.** da Fonseca, E. (Sociedade Portuguesa de Energia Solar, Lisboa, Portugal). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Portugal is a wine country with a regular production of 1100 million liters per year. Therefore it was quite natural that ethyl alcohol was used as alternative fuel for cars almost from the beginning, mainly in rural areas, but the low price of gasoline put an end to this practice, except in the colony of Mozambique. Now, interest in alcohol fuels was renewed. Studies in intensive cultures with the help of solar energy systems are in the way and work is being done in the adaptation of Otto engines to 100% ethanol consumption.

35172 (CONF-801030—(Vol.2), pp 849-854) **Alcohol cars in Brazil's future: a technological forecast.** Goodrich, R.S. (Univ. of Sao Paulo, Brazil). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The purpose of this paper is to show that a long-range study of the situation is needed and to pose an integrated technological forecast of the role of the alcohol automobile in the future as the logical starting point for this planning effort. A technology assessment of the complex PROALCOOL program clearly indicates the desirability of establishing a large (11 to 14 million) fleet of alcohol cars by the year 2000 in order to maintain reasonable importation limits on petroleum. Such a massive fleet of alcohol cars cannot be considered as a novelty add-on feature, but must have its production volumes and fleet growth rates throughly planned to be commensurate with the expected overall growth dynamics of the total passenger vehicle fleet. Thus, the basic objective of this study is to present reasonable forecasts of: the growth of the total automotive fleet to the year 2000; the production rates of 0-Km alcohol cars and conversion rates of gasoline to alcohol-fueled cars during this period; the dynamics of substitution of the alcohol fleet into the total fleet; the evolution of fuel efficiency (Km/l) and vehicle utilization (l/y) in the future; and the alcohol fuel demand schedule for these vehicles in the future.

35173 (CONF-801030—(Vol.2), pp 855-859) **Utilization of methanol from natural gas as a fuel.** Hirakawa, S. (Univ. of Tokyo, Japan); Hiwada, R. 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

The Ministry of International Trade and Industry in Japan will establish Alternative Energy Development Organization for the purpose of research and development of new alternative forms of energy to oil. In Japan, plans have already been in progress to use methanol as a boiler fuel for thermal generating plants, and basic experiments and tests for boiler combustion of methanol have been made at many laboratories, thus making Japan lead the world by far in this field. Moreover, the research and development of methanol utilization as a fuel for automobiles in the form of a mixture with gasoline and 100 percent methanol has been started by government and industry. Once the methanol combustion system at power plants is put to practical use, the energy consumed there is so huge that natural gas resources would be the only raw material currently available. We will also, in this paper, refer to the feasibility study on importing methanol as a fuel from countries near Japan, and to the new concept of an offshore methanol production plant on offshore gas fields around Japan.

35174 (CONF-801030—(Vol.2), pp 861-867) **Technology assessment of PROALCOOL.** da Silva Leme, R.A. (Univ. of Sao Paulo, Brazil). 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Technology Assessment (hereafter designated TA) aims especially to detect the negative impacts on society provoked by the introduction of a new technology and, through policy options and changes in the technology, to reduce the negative and enhance the positive impacts. The State-of-the-Art is a full description of the technology under consideration, with emphasis on the technoeconomic coefficients corresponding to the quantity and value of inputs per unit of product output. Actual operating coefficients and not just optimal efficiency coefficients must be investigated. The State-of-Society is a description of the social, demographic, economic, political, institutional, and ecological aspects of society which are relevant to the examination of technological impacts. The forecast-

ing phase generates an image of group of images of the future technology and state-of-society. The Scenario phase consists of preparing self-consistent groups of forecasts which describe alternative futures for the country or region relevant to the assessment. The Technological Strategies are descriptions of the various technological alternatives in their current and futurized forms. A Description of Impacts is derived from the implementation of the diverse technological strategies into the various scenarios, and these impacts are then assessed. Highly negative impacts should suggest the introduction of new or modified technological strategies, whose consequences will in turn have to be assessed. The process terminates with Recommendations which propose policies that should improve the conditions identified in the previous steps of the process.

35175 (CONF-801030—(Vol.2), pp 869-874) **Objectives and first results of the German Federal Alcohol Fuels Project.** Quadflieg, H.; Bandel, J. 1980. NTIS (US Sales Only), PC A19/MF A01. Order Number DE81903754.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

In Germany the road traffic is almost completely dependent on oil products. Alcohol technology represents the predominating subject within the R and D program Alternative Energy Sources for Road Traffic initiated by the FMRT, timed from 1979 to 1982, and supported by a governmental fund of 135 Million DM. Five fuel and engine concepts are investigated: M15, methanol-gasoline-blend with 15% methanol for SI-engines (1050 cars); M100, neat methanol for SI-engines (130 cars); methanol-gas oil-blend (15%) and ethanol-gas oil-blend (20%) for Diesel engines (100 cars); neat methanol for Diesel-engines using additional spark ignition (3 - 20 cars); and methanol-gas oil-dual fuel operation in Diesel engines (12 cars). Methanol can be produced from domestic raw materials. Whereas M15 can be utilized in slightly adapted engines based on today's series production, new engines have to be designed to gain the full possible benefits from neat methanol. The M15-fleet test has been started in November 1979, for which a network of 30 M15-filling stations spread over the whole country secures the fuel supply. The other concepts will follow with fleet demonstrations in the course of 1980. Until now neither at the infrastructure for fuel supply nor at the road vehicles results have been found which basically could object the introduction of a methanol-gasoline blend fuel.

35176 (DOE/CS/50023—T15) **Project for reliability fleet testing of alcohol/gasoline blends. Technical progress report.** (Aerospace Corp., El Segundo, CA (USA). Mobile Systems Directorate). Jul 1981. Contract AC03-79CS50023. 85p. NTIS, PC A05/MF A01. Order Number DE82000004.

The Project Plan addresses the near-term goal of bringing the end-use technology for formulated alcohol/gasoline blends to the point of commercial technical readiness, in support of the Alcohol Fuels Program element of the DOE Alternative Fuels Utilization Program (AFUP). A 4-year project was planned initially. The project addresses two activities: (1) to acquire data for proof-of-concept through engineering tests in a small controlled fleet using various formulated blends of ethanol/gasoline and methanol/gasoline and (2) to acquire data for statistical proof-of-performance through large-scale reliability fleet tests using selected blends. Implementation of the plan is continuing in accordance with funding availability and significant progress has been made on many elements of the tests. Progress is reported in detail. (WHK)

35177 (DOE/IR/10855—T1) **Alcohol fuels grant program at Lincoln Land Community College, Springfield, Illinois. Final report.** (Lincoln Land Community Coll., Springfield, IL (USA)). 1981. Contract FG02-80IR10855. 14p. NTIS, PC A02/MF A01. Order Number DE82000744.

An account of several activities conducted by the college as a part of this research program is presented. A tri-star still has been produced during demonstrations and workshops. Two cars have been converted to run on the fuel produced from the college still. Preliminary trials of a converted John Deere tractor using ethanol and water are reported. Information on the curriculum developed as part of this program is presented. (DMC)

35178 (PB—81-134793, pp vp, Paper 1) **End use of fluids from biomass as energy resources in both transportation and non-transportation sections.** Adelman, H.; Pefley, R.; Browning, L.; D'Eliscu, P.; Murthy, B.; Pullman, B. (Univ. of Santa Clara, CA). Sep 1980. NTIS. Order Number DE81904166.

In Energy from biological processes. Volume III. Appendices. Part C: Select conversion technologies and end use.

The segments of the transportation sector are classed by type of engine (spark ignition, compression ignition, or gas turbines), fuel (gasoline or distillate), and vehicle use (automobiles, trucks, aircraft, marine, rail, buses). The factors of assessment that were considered in addition to cost are: fuel properties, engine and fuel system, and environment. The substitute fuels considered are methyl alcohol, ethyl alcohol, and synthesis gas. Each engine type is considered as a potential candidate for alternate liquid fuels and gaged with the specific assessment factors. The alternate liquid fuels are assessed in pure form and blended with traditional hydrocarbon fuels. Assessment of biomass liquids as fuels for stationary combustion utilization was also conducted. The combustion systems included are: large power and process steam systems, gas turbines for power, CI and SI engines for power, small commercial burners, and domestic heaters. The biomass fuels assessed are: unrefined fuels (wastes) and refined fuels (methanol, ethanol, methane). The stratified charge engine, Stirling engine, fuel cell, and the catalytic combustor have also been briefly examined.

# 36 MATERIALS

*REFER ALSO TO CITATION(S) 34514*

35179 **Deburring technology for improved manufacturing.** Gillespie, L.K. (ed.). Dearborn, MI; Society of Manufacturing Engineers (1981). 652p. (GJBX—613-2573).

In 1976 SME published the first comprehensive English language book on deburring capabilities. That book, Deburring Capabilities and Limitations, has become the benchmark in identifying basic approaches to reducing deburring costs and identifying process capabilities. It is both a basic primer and a handbook for those who are familiar with deburring processes. That book was soon followed by Advances in Deburring. This book is a companion volume to both of the above books. It is a definitive collection of new facts and observations about reducing burr-related costs. There is essentially no duplication of material among these books. The material included represents new research, a different variation of a process or a significantly different application or definition of capabilities. As in the previous books, the information presented is based on the work of many industry leaders. Most of this material was first presented in 1978 SME conferences on deburring.

## 3601 Metals And Alloys

*REFER ALSO TO CITATION(S) 34204, 34362, 34384, 34484, 34659, 34708, 34709, 34710, 34711, 34712, 34713, 34714, 34715, 34716, 34717, 34718, 34719, 34720, 34721, 34722, 34723, 34724, 34725, 34726, 34727, 34728, 34729, 34730, 34731, 34732, 34734, 34735, 34736, 34737, 34738, 34739, 34740, 34742, 34743, 34744, 34745, 34746, 34747, 34748, 34749, 34750, 34751, 34752, 34753, 34754, 34754, 34755, 34755, 34756, 34757, 34758, 34759, 34760, 34761, 34762, 34763, 34764, 34765, 34766, 34767, 34768, 34769, 34770, 34772, 34828, 34829, 34830, 34849, 35123, 35124, 35133, 35388, 35663, 35727, 35728, 35728, 35729, 35730, 35730*

35180 (BDX—613-2578) **Metal-finishing processes: surface-finish improvement.** Gillespie, L.K. (Bendix Corp., Kansas City, MO (USA)). Aug 1981. Contract AC04-76DP00613. 49p. NTIS, PC A03/MF A01. Order Number DE81030188.

This module is designed to provide the student with the following information: a basic understanding of the role finishing operations play in the manufacture of parts; some basic concepts of surface characteristics; a basic knowledge of surface improvement processes; and an understanding of the technical challenges posed by surface finish requirements.

35181 **(BDX—613-2680) Mechanical properties of titanium castings.** Ulitchny, M.G. (Bendix Corp., Kansas City, MO (USA)). Sep 1981. Contract AC04-76DP00613. 13p. NTIS, PC A02/MF A01. Order Number DE81030693.

Cast and hot isostatically pressed (HIP'd) Ti-6Al-4V and Ti-6Al-6V-2Sn alloys were tested for mechanical properties. Specimens from these alloys were tested in as-received, mill annealed, and solution treated and aged conditions. Results show that tensile strength at least equal to the guaranteed minimum for wrought titanium can be developed using solution treated and aged conditions. Results show that tensile strength at least equal to the guaranteed minimum for wrought titanium can be developed using solution treat and age heat treatments. The fracture toughness associated with this strength level is adequate, but tensile ductility is usually less than the desired 10 percent level. Development of modified heat treatments would likely lead to increases in ductility and would extend the uses of titanium-alloy castings.

35182 **(CONF-810809—18) Magnetic susceptibility of curium pnictides.** Nave, S.E.; Huray; P.G.; Peterson, J.R.; Damien, D.A.; Haire, R.G. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). Sep 1981. Contract W-7405-ENG-26. 2p. NTIS, PC A02/MF A01. Order Number DE82000148.

From 16. international conference on low temperature physics; Los Angeles, CA, USA (19 Aug 1981).

The magnetic susceptibility of microgram quantities of $^{248}$CmP and $^{248}$CmSb has been determined with the use of a SQUID micromagnetic susceptometer over the temperature range 4.2 to 340 K and in the applied magnetic field range of 0.45 to 1600 G. The fcc (NaCl-type) samples yield magnetic transitions at 73K and 162 K for the phosphide and antimonide, respectively. Together with published magnetic data for CmN and CmAs, these results indicate spatially extended exchange interactions between the relatively localized 5f electrons of the metallic actinide atoms.

35183 **(DOE/ER/03158—97) Point defects in crystals (including grouped defects). Report No. 4548.** Seidman, D.N. (Cornell Univ., Ithaca, NY (USA)). Aug 1981. Contract AS02-76ER03158. 21p. NTIS, PC A02/MF A01. Order Number DE82000395.

The fundamental properties of point defects, vacancies and self-interstitial atoms, in pure fcc and bcc metals is reviewed. Point defects created by both thermally-activated and irradiation processes are considered. The roles played by vacancies and self-interstitial atoms in thermal equilibrium are discussed and the best values of the enthalpy of formation of these point defects, in a number of metals, are given. Methods for obtaining fundamental properties of vacancies, such as activation volumes, mobilities, and binding enthalpies are discussed. Selected best values of mobilities and binding enthalpies of vacancies, as deduced from recovery experiments on a number of different quenched metals are listed. The problem of the production of single self-interstitial atoms and their configuration(s) is discussed. The clustering of single self-interstitials into small clusters is also considered. The physical origin of the extremely high low-temperature mobility of self-interstitials in the so-called Stage I recovery regime is also discussed.

35184 **(DOE/ER/03158—99) Field-ion-microscope observations of radiation effects.** Seidman, D.N. (Cornell Univ., Ithaca, NY (USA)). Aug 1981. Contract AS02-76ER03158. 8p. NTIS, PC A02/MF A01. Order Number DE81030934.

This article briefly reviews the unique advantages and capabilities of the field-ion microscope (FIM) and atom-probe FIM for the study of the effects of particle radiation on metals, discusses some contrast effects caused by radiation-induced defects, and gives a number of problems that have been studied using these techniques.

35185 (DOE/ER/10044—T1, pp 9p, Attachment I) **Proposal for a preliminary investigation of the selective transfer phenomenon in friction and wear.** Barash, M. 15 Jul 1981. NTIS, PC A15/MF A01. Order Number DE81025882.

In Progress report to the Department of Energy in support of basic energy and policy research.

A review of friction problems in the machinery industry is given. It is proposed that funding be made available to conduct a preliminary investigation into the phenomenon of selective transfer. (MOW)

35186 **(DOE/ET/52048—18) Comments on the hydrogen solubility data for liquid lead, lithium, and lithium-lead alloys and review of a tritium-solubility model for lithium-lead alloys.** Larsen, E.M.; Ortman, M.S.; Plute, K.E. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). May 1981. Contract AS02-78ET52048. 17p. (UWFDM—415). NTIS, PC A02/MF A01. Order Number DE81030828.

The projected use of a lithium-lead alloys as the tritium breeding blanket and heat transfer agent in fusion reactors requires data on the solubility of hydrogen isotopes in the alloys at the temperatures of interest. In the absence of available experimental data in the desired temperature range, estimates were made on the hydrogen isotope solubility in the lithium-lead alloys. In NUWMAK, solubility estimates were based on activity studies of lithium in lithium-lead while in WITAMIR the solubility was extrapolated from deuterium measurements in the alloy at higher temperatures. In this note we summarize the existing data and review our methods of estimating the tritium solubility in the desired temperature range.

35187 **(EPRI-NP—1991) Influence of cyclic load and environmental effects on stress corrosion cracking of sensitized stainless steel. Final report.** White, E.L.; Berry, W.E. (Battelle Columbus Labs., OH (USA)). Aug 1981. 62p. NTIS, PC A04/MF A01. Order Number DE81904216.

An experimental stress-corrosion cracking (SCC) study has been conducted in order to mitigate SCC in stainless steel piping in BWR's. Effect of the temperature, dissolved oxygen, and cyclic loading was studied on furnace sensitized Type 304 stainless steel. Slow strain rate tests at $4 \times 10^{-6}$ s$^{-1}$ strain rate produced intergranular stress-corrosion cracking (IGSCC) at temperatures above 204° C, suggesting a threshold temperature for IGSCC of about 130°C at the 0.2 ppM oxygen level. Saturated solutions of AgCl produced IGSCC in slow strain rate tests in both aerated (8 ppM $O_2$) and deaerated (< 0.06 ppM $O_2$) tests at temperatures as low as 85°C. Results suggest a potential hazard in using Ag/AgCl reference electrodes. IGSCC also was produced by trapezoidal cyclic loading (5 min load/unload, 10 or 75 min at load). Tests in 8 ppM oxygen water with the 75 min hold cycle, minimum load of 0.1 yield strength (YS) and maximum load greater than YS, indicated a threshold temperature for IGSCC of 190°C. Other cyclic load tests in 288°C - 8 ppM oxygen water with minimum load of 0.1 YS and maximum load less than YS, produced IGSCC at maximum loads as low as 0.7 YS in the rather high yield strength material studied (YS = 36.3 ksi at 288°C). Low increment load cyclic loading produced IGSCC with cyclic loads ranging between 0.5 and 0.6 YS and 0.8 to 0.9 YS, but not at 0.6 to 0.7 YS or 0.7 to 0.8 Ys. The short hold cycle (10 min at load) was much less aggressive in promoting IGSCC than the long hold cycle (75 min at load).

35188 (EPRI-WS—79-174-Vol.3, pp 20p, Paper 49) **Hot ductility and grainboundary precipitates in austenitic stainless steels.** Abe, S.; Kurosawa, F.; Yamaguchi, S. (Nippon Steel Corp., Kawasaki, Japan). May 1980. NTIS, PC A14/MF A01. Order Number DE82900056.

From Seminar on countermeasures for pipe cracking in BWRs; Palo Alto, CA, USA (22 Jan 1980).

Hot cracking of austenitic stainless steels may occur not only in welding but also in continuous casting (CC) and hot working. Type 304 is mostly continuously casted as well as Type 316 and 321 in commercial production processes. However, there are many difficulties at present in CC of Type 347 due to the susceptibility to hot cracking. In the present study, the authors have tried to clarify the key metallurgical factors which increase the susceptibility to hot cracking of various austenitic stainless steels mainly of Type 347 by Gleeble test and SPEED method (Selective Potentiostatic Etching by electrolytic Dissolution Method) which has been recently developed at the laboratories.

35189 **(GA-A—16389) Effect of microstructure on the mechanical properties of a commercial 12Cr-1Mo steel (HT-9).** Lechtenberg, T.A. (General Atomic Co., San Diego, CA (USA)). Aug 1981. Contract AT03-76ET51011. 8p. (CONF-810831—57). NTIS, PC A02/MF A01. Order Number DE82000082.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

The microstructure of a commercial 12Cr-1Mo steel (HT-9) and its associated effect on strength and toughness properties is being studied in a continuing program aimed at qualifying the alloy for use in fusion energy machines. Interim results show this alloy is subject to a degree of tempered martensite embrittlement and temper embrittlement. For applications projected for fusion machines at lower temperatures, a new heat treatment (1000°C, 1 h, air-cooled followed by 650°C tempering) at lower temperatures and shorter times than the vendor-recommended heat treatment has been identified. Microstructural differences between the treatments are discussed, and mechanical properties are correlated. 6 figures.

35190 **(HEDL-SA—2336-FP) Void swelling in the molybdenum alloy TZM irradiated to high fluence.** Gelles, D.S.; Peterson, D.T.; Bates, J.F. (Hanford Engineering Development Lab., Richland, WA (USA)). 1981. Contract AC14-76FF02170. 6p. (CONF-810831—41). NTIS, PC A02/MF A01. Order Number DE81029802.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

Microstructural development and density change measurements are reported for TZM, a commercial molybdenum base alloy, following fast neutron irradiation in EBR-II to high fluence over the temperature range 400 to 650°C. Uniformly distributed voids arrayed in a lattice and constituting 3% swelling were observed following irradiation at 650°C to 14.7 x $10^{22}$ n/cm$^2$ (E > 0.1 MeV) (53 dpa). Nonuniformly distributed rafts of voids in lattice arrays were observed following irradiation at 540°C to 13.6 x $10^{22}$ n/cm$^2$. Void swelling was not resolved following irradiation at 425° C to 12.2 x $10^{22}$ n/cm$^2$. Void swelling measurements corroborated density change results which showed peak void swelling behavior saturating at 590°C. Two mechanisms for the behavior observed are considered; the first is based on an apparent maximum void size of 10 nm which leads to void rafting and eventually to void swelling saturation. Saturation is predicted only after $10^{24}$ n/cm$^2$ (360 dpa) with 20% swelling possible. The second mechanism considers the effect of a developing void lattice on dislocation dynamics. In either case, at goal fluence for a fusion reactor first wall, only 4% swelling is anticipated which would not represent a design limitation.

35191 **(HEDL-SA—2474-FP) Fracture toughness testing on ferritic alloys using the electropotential technique.** Huang, F.H.; Wire, G.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 11 Jun 1981. Contract AC14-76FF02170. 19p. (CONF-810831—43). NTIS, PC A02/MF A01. Order Number DE81029776.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

Fracture toughness measurements as done conventionally require large specimens (5 x 5 x 2.5 cm) which would be prohibitively expensive to irradiate over the fluence and temperature ranges required for first wall design. To overcome this difficulty a single specimen technique for J intergral fracture toughness measurements on miniature specimens (1.6 cm OD x 0.25 cm thick) was developed. Comparisons with specimens three times as thick show that the derived J/sub 1c/ is constant, validating the specimen for first wall applications. The electropotential technique was used to obtain continuous crack extension measurements, allowing a ductile fracture resistence curve to be constructed from a single specimen. The irradiation test volume required for fracture toughness measurements using both miniature specimens and single specimen J measurements was reduced a factor of 320, making it possible to perform a systematic exploration of irradiation temperature and dose variables as required for qualification of HT-9 and 9Cr-1Mo base metal and welds for first wall application. Fracture toughness test results for HT-9 and 9Cr-1Mo from 25 to 539°C are presented to illustrate the single specimen technique.

35192 **(RFP—3125) Silver films for solid state bonding.** Naimon, E.R.; Kurtz, R.G.; Vigil, D.; Williams, L. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 13 Aug 1981. Contract AC04-76DP03533. 13p. NTIS, PC A02/MF A01. Order Number DE82000414.

Silver films deposited from a hot hollow cathode source continue to be instrumental in promoting high-strength solid state bonds at Rocky Flats. As a result, there is a continual need for acquiring basic understanding of the deposition process and the characteristics of the film itself. Current research studies are concerned with such phenomena as effects of surface condition prior to coating, effects of varying times between coating and bonding, and effects of film thickness on bond strength.

35193 **(SAND—81-0884) Mechanical properties of a 4142 steel pressure vessel for auxiliary closures.** Soo Hoo, M.S. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1981. Contract AC04-76DP00789. 29p. NTIS, PC A03/MF A01. Order Number DE81030983.

Tensile, fracture toughness, and stress corrosion cracking susceptibility measurements have been performed on an AISI 4142 seamless steel tubing material. This steel tubing is a candidate pressure vessel material for use in underground door closure systems at Nevada Test Site. Experiments indicate that while the post weld heat treatment produces a uniform weld, the weld zone is the region most susceptible to stress corrosion cracking from water.

35194 **(SAND—81-1485C) Ferritin deposition on tungsten and its desorption in a high electric field.** Panitz, J.A. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 5p. (CONF-811113—4). NTIS, PC A02/MF A01. Order Number DE81030122.

From American Vacuum Society national symposium; Anaheim, CA, USA (3 Nov 1981).

The interaction of an organic molecule with other molecules or a metallic substrate can influence the course of many physical and biological reactions. The high resolution electron microscope can probe details of molecular structure, but is generally restricted to an examination of two dimensional molecular crystals, or individual molecules stained with heavy metals and placed on nonmetallic substrates. X-ray crystallography can examine molecular structure within an ordered crystal of molecules, but cannot examine a metal-molecule interface. The Field-Electron Emission Microscope and Field-Ion Microscope have the potential to image molecules at a metal-molecule interface, but imaging attempts have not been particularly successful. Organic and biological molecules deposited on clean metal surfaces produced images that were either highly structured, but unrelated to a molecule's known conformation; or were transient, or nonreproducible. Controlled field-desorption has been tried to probe the structure of molecules deposited on a metal surface. Recently, this method has yielded reproducible images of unstained ferritin clusters and individual ferritin molecules placed on a tungsten substrate.

35195 **(Y—2251) Dimensional stability, annealing stabilization, and residual stress analysis of alpha-phase-extruded uranium-2.4 weight percent niobium alloy.** Anderson, R.C.; Kollie, T.G.; Reeves, C.A. Jr. (Oak Ridge Y-12 Plant, TN (USA)). 30 Sep 1981. Contract W-7405-ENG-26. 19p. NTIS, PC A02/MF A01. Order Number DE82000261.

The structural use of alpha-extruded uranium-2.4 wt % niobium (U-2.4Nb) alloy rod was hampered by dimensional instability of the alloy. To develop an understanding of (and a solution to) the problem, the metastable state of the as-extruded and heat-treated alloy was studied with regard to its susceptibility to creep and cracking, its retention of residual stresses, and its dimensional stability. An annealing treatment of 600°C for 30 minutes stabilized the structure and reduced residual stresses and improved dimensional stability. 12 figures, 2 tables.

35196 **Search for superconductivity at high pressures in Eu, $EuMo_6S_8$, and $EuMo_6Se_8$.** Shelton, R.N.; Moodenbaugh, A.R. (Ames Laboratory-U. S. Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). W-7405-ENG-82; WPAS-KC-02-02-02;DE-AC02-76CH00016. *Physical Review* [*Section*] *B: Condensed Matter ;* **24**: No. 5, 2863-2866(1 Sep 1981).

Electrical resistance measurements between 1.4 K and room temperature at pressures up to 130 kbar on Eu, and between 90 and 130 kbar on $EuMo_6S_8$ and $EuMo_6Se_8$ yield no indication of a superconducting transition in any of these materials. The temperature de-

pendence of the resistance of Eu at 130 kbar is consistent with antiferromagnetic order. Neither $EuMo_6S_8$ nor $EuMo_6Se_8$ displays resistance versus pressure behavior which might indicate a phase transition.

35197 **Determination of the H distribution in reactively sputtered amorphous silicon-hydrogen alloys by proton nuclear magnetic resonance.** Jeffrey, F.R.; Lowry, M.E. (Ames Laboratory-USDOE and Department of Physics, Iowa State University, Ames, Iowa 50011). W-7405-ENG-82. *Journal of Applied Physics ;* **52**: No. 9, 5529-5533(Sep 1981).

Data are presented for a series of samples of varying H content which show a-Si:H to contain both a random, dilute distribution of H and a form of clustering. The dilute phase is shown to have a local H density of approximately $3.5 \times 10^{21}$ $cm^{-3}$ regardless of the overall H content of the film. This phase appears to exist in up to 88% of the film's volume. The clustered form appears to also have a configuration which is independent of sample-wide average H density. Several possible models for the clusters which could explain the data are explored.

35198 **Optical properties of diffusion-formed $Au_2Al$.** Inagaki, T.; Arakawa, E.T.; Callcott, T.A. (Department of Physics, Osaka Kyoiku University, Tennoji, Osaka 543, Japan). *Journal of Applied Physics ;* **52**: No. 9, 5597-5602(Sep 1981).

Ellipsometric measurements have been made on the intermetallic compound $Au_2Al$ to determine the optical constants for photon energies between 0.6 and 3.7 eV. Polycrystalline samples were prepared by the interdiffusion between evaporated thin fils of Au and Al. The optical properties are characteristic of a metallic conductor with an interbrand threshold of about 0.8 eV. The results are compared with optical data for Au, Al and $AuAl_2$, and with x-ray photoeletron and soft x-ray emission spectra for $Au_2Al$. As compared with pure gold, it is concluded that interband adsorption is greatly enhance relative to the free-carrier absorption and that d-band electrons do not contribute significantly to the absorption observed below 3.7 eV.

35199 **Critical fields H/sub c/ and H/sub c/2 of superconducting niobium.** Kerchner, H.R.; Christen, D.K.; Sekula, S.T. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Physical Review [Section] B: Condensed Matter ;* **24**: No. 3, 1200-1204(1 Aug 1981).

New measurements of the thermodynamic critical field H/sub c/ and the upper critical field H/sub c/2 of a niobium crystal are interpreted by using realistic microscopic theory. The theory of H/sub c/2 combined with band theory allows the H/sub c/2 measurements to be compared with de Haas—van Alphen measurements. Eliashberg theory allows the H/sub c/ measurements to be compared with other experiments that are sensitive to the electron-phonon interaction. Our measurements of H/sub c/2 confirm the band theory of niobium as adjusted to match de Haas—van Alphen data. Our measurements of H/sub c/ enable us to deduce the value of the electron-phonon-coupling parameter $\lambda$. Finally, we note a discrepancy between the value of the renormalization parameter $1+\lambda$ that is needed to match the H/sub c/2 data with the band theory and the value of $1+\lambda$ that is required to give the observed H/sub c/.

35200 **Magnetic excitations in chromium.** Fincher, C.R. Jr.; Shirane, G.; Werner, S.A. (Brookhaven National Laboratory, Upton, New York 11973). DE-AC02-76CH00016. *Physical Review [Section] B: Condensed Matter ;* **24**: No. 3, 1312-1322(1 Aug 1981).

We have investigated the magnetic excitations of the spin-density wave in pure chromium using inelastic neutron scattering. Data on spin-wave modes originating from the incommensurate magnetic Bragg reflections show the polarization of the spin waves to be highly anisotropic. A new additional excitation is observed with a commensurate wave vector and is interpreted as a feature specific to the transverse spin-density wave. We also present scattering data near and above the Neel point T/sub N/. While we do not observe a divergence of the susceptibility at the incommensurate satellite positions for T approaching T/sub N/, there is a large increase in the diffuse scattering throughout a broad region of the reciprocal lattice near (0, 0, 1). We suggest connections between these data and the theory of itinerant magnetism developed in Moriya and Kawabata.

35201 **Neutron reflection as a probe of surface magnetism.** Felcher, G.P. (Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Physical Review [Section] B: Condensed Matter ;* **24**: No. 3, 1595-1598(1 Aug 1981).

Polarized neutrons reflected from the surface of a ferromagnet are sensitive to the magnetization close to the surface as well as to the bulk magnetization. In a calculation using parameters appropriate to nickel it is shown how the two contributions can be separated. Neutron measurements can determine the first moment of the magnetic disturbances at the surface, with a sensitivity corresponding to one magnetic dead layer.

35202 **Effect of strain on the martensitic phase transition in superconducting $Nb_3Sn$.** Hoard, R.W.; Scanlan, R.M.; Smith, G.S.; Farrell, C.L. (Lawrence Livermore Lab, Calif). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-17**: No. 1, 364-367(Jan 1981). (CONF-800980—).

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

The connection between the cubic-to-tetragonal martensitic phase transformation and the phenomenon of superconductivity in A15 compounds is investigated. The degradation of the critical parameters, such as T/sub c/, H/sub c2/, and J/sub c/, with mechanical straining is of interest. Since martensitic transitions are also known to be strain sensitive, perhaps the structural change is directly responsible for the reduction in superconducting properties. Low-temperature x-ray diffraction experiments on $Nb_3Sn$ ribbons, mounted on copper and indium sample stages are reported. The cryostat used is unique in that it has a vacuum mechanical insert which allows the superconductor to be placed under compressive and tensile strains while at low temperatures. Results indicate that the martensitic phase transition temperature, T/sub m/, increases with compressive strains. Other effects of strain on tetragonal phase production are discussed. 14 refs.

35203 **Josephson effects in $Nb_3Sn$ microbridges.** Lee, T.W.; Falco, C.M. (Argonne Natl Lab, Ill). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-17**: No. 1, 85-87(Jan 1981). (CONF-800980—).

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

Josephson effects in long narrow Nb/sub 3/Sn microbridges at temperatures up to 17 K were studied. These microbridges are formed by photolithographic techniques and subsequently subjected to controlled electrical discharges to modifY the intrinsic T/sub c/ of the bridge region. The bridges exhibit 10 GHz microwave steps in their I-V characteristics whose amplitudes are in agreement with the Resistively Shunted Junction (RSJ) model. I-V characteristics can be fit assuming an effective temperature approximately 15 K above the bath temperature. Structures in the I-V characteristics in the absence of microwaves were also investigated. It was demonstrated that phase-slip centers are induced at weak superconducting positions along the bridge when the S-N boundarY of an expanding hot spot reaches within a thermal healing distance. The critical current of the phase-slip center thus formed exhibits a temperature dependence (1-T/T/sub c/)/one-half/ insteady of the usual mean field result (1-T/T/sub c/)/sup 3/2/. 12 refs.

35204 **Development of long continuous $Nb_3Ge$ tape conductors with high current density at elevated temperature and field.** Maley, M.P.; Newkirk, L.B.; Thompson, J.D.; Valencia, F.A. (Los Alamos Sci Lab, NM). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-17**: No. 1, 533-540(Jan 1981). (CONF-800980—).

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

Superconductors based on Nb/sub 3/Ge have been fabricated by the chemical vapor deposition (CVD) process in continuous lengths up to 20 m. This material exhibits a transition temperature

T/sub c/> 21.0 K and a self field critical current density J/sub c// greater than equivalent to/2.5*10/sup 6/ A/cm/sup 2/ at 14 K and offers the possibility of high current operation at temperatures >14.0 K. Values of J/sub c/ measured in high magnetic fields exceed 8*10/sup 4/ A/cm/sup 2/ at 18T and at 4 K. The material development that resulted in reproducing excellent short sample superconducting properties on long continuous lengths of tape is described. The tapes consist of 3-6/mu/m of Nb/sub 3/Ge coated completely around 0.64-cm-wide, 25-/mu/m-thick substrates of Cu, Ni, or Cu-clad stainless steel. More than 150 m of this tape has been fabricated for use in winding a 1-m prototype transmission cable. AC-loss measurements on short samples of the long tapes show complete shielding of the substrate and losses which are acceptably low for power transmission applications. 28 refs.

**35205 NbN materials development for practical superconducting devices.** Kampwirth, R.T.; Gray, K.E. (Argonne Natl Lab, Ill). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-17**: No. 1, 565-568(Jan 1981). (CONF-800980—).

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

Power switches such as a superconducting fault current limiter require large cross sectional area superconductors with high critical current density J/sub c/ and normal state resistivity /rho/ sub //n. Large values of J/sub c/ and /rho/sub //n have been previously reported in small cross sectional area "weak limits" of NbN. Reactively sputtered NbN films up to 5 /mu/m thick and 2.2 cm wide which have /rho/sub //n>200 /mu/sub O/MEGA/ cm and a self-field J/sub c/ up to 10/sup 6/ A/cm/sup 2/ are reported. Degradation in J/sub c/ was observed with increasing film width and for millisecond current pulses. This degradation could be reduced by stabilization with either low /rho/sub //n normal metal or a sapphire substrate. The resistivity and critical current dependence both imply Josephson coupled grains and the results are discussed within that model. 11 refs.

**35206 X-ray-diffraction and SIMS analysis of steam-oxidized Incoloy 800.** Bittner, H.F. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *High Temperature Science ;* **12**: No. 4, 231-247(Dec 1980).

In situ-formed oxide coatings have been proposed as tritium permeation barriers for candidate materials in heat exchangers. In this regard oxides formed by steam oxidation of Incoloy 800 in 243 and 532 torr steam at 933 K and in 714 torr steam at 793, 933, and 998 K, for exposure times up to 5000 h, have been chemically analyzed, using x-ray diffraction techniques and secondary-ion mass spectrometry (SIMS). Effects of sample pretreatment, including electropolishing and annealing, were studied. Both annealed and unannealed material that was electropolished formed, after exposure times up to 672 hours, a thick oxide comprised primarily of $\alpha Fe_2O_3$, Fe(Cr/sub 1-x/Fe/sub x/)$_2O_4$, and $Cr_2O_3$. At moderate exposure times (144 h or more) evidence of spalling of the outer layer of the oxide was apparent. In the case of annealed material, spalling of the outer iron oxide layer was complete after about 672 h, leaving a layer of (Cr/sub 1-x/Fe/sub x/)$_2O_3$ and Mn(Cr/sub 1-x/Fe/sub x/)$_2O_4$; longer exposure of annealed material resulted in a thicker oxide consisting of these species. In the case of annealed materials, a similar transformation was indicated, but was not complete up to the longest exposure time studied for this material, 1560 h. The annealed sample exposed at 998 K contained $\gamma$ $Mn_2O_3$ at the surface of the oxide.

**35207 Diffusion bonded stainless steel in a copper matrix for forming amorphous metal shapes.** (to Dept. of Energy). US Patent Application 204,689. 6 Nov 1980. 18p.

This patent relates to a quenching wheel whose circumferential surface has been modified with inserts of low thermal conductivity, so that amorphous metal ribbons can be formed with a pattern of embrittled zones. The amorphous metal can be any of the magnetic alloys, such as $Fe_{80}B_{20}$, $Fe_{40}Ni_{40}P_{14}B_6$, or $Fe_{81.5}B_{14.5}Si_4$. (DLC)

**35208 Mechanical properties of vanadium and vanadium-base alloys.** Harrod, D.L.; Gold, R.E. (Westinghouse Electr Corp, Tampa, FL). *International Metals Reviews ;* **25**: No. 4, 163-221(1980).

The information available is summarized to provide a description of interstitial effects on tensile, creep, fatigue, and ductility behaviour. A number of substitutional solutes have been studied as binary, ternary, and higher order alloying additions; data for these systems are discussed with regard to comparative strengthening effects. Additional discussion focuses on deformation and fracture behaviour and mechanisms, the importance of grain size and other microstructural features, recovery and recrystallization features, recovery and recrystallization phenomena, phase relationships and solubilities, solute diffusivity, and elastic properties. 119 refs.

## 3602 Ceramics, Cermets, And Refractories

*REFER ALSO TO CITATION(S) 34204, 34289, 34353, 34384, 34791, 35001, 35001, 35004, 35004, 35087, 35581*

**35209 (DOE/ER/10591—2) Mechanisms of elevated-temperature in single phase ceramics. Progress report, February 1, 1981-January 31, 1982.** Solomon, A.A. (Purdue Univ., Lafayette, IN (USA)). Sep 1981. Contract AC02-80ER10591. 87p. NTIS, PC A05/MF A01. Order Number DE82000691.

The quadrupole mass spectrometer system has been completed, calibrated and tested, and used to analyze swelling and rupture transients in nickel and $UO_2$. An automatic data acquisition system was also designed and built to feed all temperature, pressure, displacement and released gas signals directly to the Purdue PDP-11 computer for data reduction and tabulation. Swelling and gas release studies were completed on Ni and initiated on $UO_2$. A method was developed to fabricate tensile creep specimens of CoO and $UO_2$ using slip-casting and isostatic compaction. The assembly and testing of the thoriated tungsten constant-true-stress creep machine was also completed for testing appropriately-shaped specimens. Sintering studies carried out on $UO_2$ in the thoriated tungsten pressure vessel at high ambient pressure, indicated that sintering was impeded in the tungsten vessel. It was inferred that tungsten contaminates $UO_2$ and reduces sintering rates. Finally, a system was designed and built to test ceramics under relatively high oxygen pressure. Tensile creep specimens of CoO were produced by oxidation of performed metal specimens. Tensile creep deformation was performed on two CoO specimens of ~ 95%TD from 1100 to 1300°C in air at low stress levels. The results indicate, for the first time, superplastic strains in a porous ceramic under tensile loading.

**35210 (DP-MS—81-44) Leaching of nuclear-waste forms.** Stone, J.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1981. Contract AC09-76SR00001. 17p. (CONF-810956—1). NTIS, PC A02/MF A01. Order Number DE81030490.

From Federation of Analytical Chemistry and Spectroscopy Societies meeting; Philadelphia, PA, USA (20 Sep 1981).

This paper presents an overview of leach test methods and of factors that affect leaching of nuclear waste solids. Some of the analytical requirements are discussed.

**35211 Elimination of magnetic-susceptibility broadening in NMR using magic-angle sample spinning to measure chemical shifts in NbH/sub x/.** Stoll, M.E.; Majors, T.J. (Sandia National Laboratories, Livermore, California 94550). *Physical Review [Section] B: Condensed Matter ;* **24**: No. 5, 2859-2862(1 Sep 1981).

Magnetic-susceptibility broadening of hydrogen NMR spectra in NbH/sub x/ powders (x = 0.10 and 0.17) has been eliminated using magic-angle sample spinning. This has made it possible to measure two underlying hydrogen chemical-shift sites with shielding values of $\alpha_0 = -12.0 \pm 0.5$ ppm and $\beta_0 = +16.0 \pm 0.5$ ppm with respect to tetramethyl silane.

**35212 Neutron scattering study of the soft optic mode in $SrTiO_3$ under a high magnetic field.** Comes, R.; Shapiro, S.M.; Frazer, B.C.; Shirane, G. (Laboratoire de Physique des Solides, Associe au Centre National de la Recherche Scientifique, Universite Paris-Sud, 91405 Orsay, France). *Physical Review [Section] B: Condensed Matter ;* **24**: No. 3, 1559-1561(1 Aug 1981).

According to the vibronic theory of ferroelectric phase transitions, appreciable shifts in T/sub c/, with corresponding shifts in soft-mode frequencies, should be observable under high-magnetic-field conditions. The field effects have been predicted to be much larger in wide-gap than in narrow-gap materials. Neutron scattering measurements on the soft optic zone-center mode in $SrTiO_3$ were carried out under magnetic field up to 70 kOe over a temperature range of 4.5 to 50 K. No magnetic-field-induced shifts of the soft-mode frequency were observed.

35213 **High-temperature thermodynamic properties of the thorium-oxygen system.** Ackermann, R.J.; Tetenbaum, M. (Argonne National Lab., IL). *High Temperature Science ;* **13**: No. 1, 91-105(1980).

The thermodynamic properties of the thorium-oxygen system at high temperatures have been investigated by means of mass effusion, mass spectrometric, and transpiration techniques over compositions ranging from the congruently vaporizing composition to the lower phase boundary composition. A very sharp decrease in oxygen potential occurs when stoichiometric thoria is reduced but slightly from the stoichiometric composition. The small extent of reduction over a wide range of oxygen potentials measured in the temperature range 2400 to 2655°K is a clear illustration of the higher stability of the ThO/sub 2-x/ phase compared with actinide-oxides such as UO/sub 2-x/, PuO/sub 2-x/, as well as other metal oxide systems. Estimates of Δ anti H/sub $O_2$/, Δ anti S/sub $O_2$/, and the standard free energy of formation of bivariant ThO/sub 2-x/ compositions have been made. A substantial increase in the total pressure of thorium-bearing species occurs when stoichiometric thoria is reduced toward the lower phase boundary. The increase in pressure can be attributed primarily to the increasing contribution of the ThO gaseous species. Total pressures of thorium-bearing species above ThO/sub 2-x/ compositions calculated by means of experimental oxygen potentials and the known or estimated free energy of formation values of the gaseous species and condensed phase are in reasonable agreement with experimental values. 8 figures, 3 tables.

## 3603 Composite Materials

*REFER ALSO TO CITATION(S) 35008, 35322, 35333*

35214 **Glass fiber composition.** Wolf, G.A.; Kupfer, M.J. (to Dept. of Energy). US Patent Application 218,243. 19 Dec 1980. 6p.

The invention relates to a glass fiber composition useful for thermal insulation having a low melting temperature and high chemical durability.

## 3604 Polymers And Plastics

*REFER ALSO TO CITATION(S) 35124, 35210*

35215 **(SAND—81-0240) W76 elastomers/propellant compatibility.** Martinez, J.I.; Bouchard, D.A. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1981. Contract AC04-76DP00789. 25p. NTIS, PC A02/MF A01. Order Number DE81031933.

Two studies were conducted to address the survivability of unsealed section materials in a C-4 propellant outgassing environment. The first study addressed the compatibility of various materials, including the elastomers, in an exaggerated environment created by using an unrealistically large ratio of propellant to materials. Although most materials fared reasonably well in the test, it became obvious that further investigation of the elastomeric seals was necessary. The second study addressed the behavior of the elastomeric seals in a more realistic environment.

35216 **(UCRL—86034) Stressed Kevlar strand test.** Golopol, H.; Clarkson, J.; Moore, R.; Hetherington, N. (Lawrence Livermore National Lab., CA (USA); Geneticon, Berkeley, CA (USA)). 10 Sep 1981. Contract W-7405-ENG-48. 16p. (CONF-810953—3). NTIS, PC A02/MF A01. Order Number DE81030769.

From JOWOG-12 conference; Aldermaston, UK (21 Sep 1981).

Kevlar is a polyaramid fiber used in fiber composites. In order to characterize this material, we determined the effect of time, temperature, and chemical environment on the strength retention of stressed Kevlar strands. In this work, we applied a stress load of 20% of the ultimate tensile strength (UTS). Strands were hung with a suitable weight in a closed container. Each container was then provided with its own heater and chemical environment. No significant loss of strength retention was found on these stressed strands. 4 figures, 5 tables.

35217 **$^1H$ nuclear magnetic resonance studies of domain structures in polymers.** Cheung, T.T.P.; Gerstein, B.C. (Ames Laboratory-DOE, and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics ;* **52**: No. 9, 5517-5528(Sep 1981).

The structures of amorphous (noncrystalline) domains in polyethylene, conditioned (at 150 °C for 15 min) and unconditioned polypropylene films and a vitrain portion of Kentucky No. 6 coal have been investigated using the Goldman-Shen NMR pulse sequence which monitors the transfer of $^1H$ magnetization from the amorphous to the crystalline domains. The diffusion equation is solved with respect to such transfer. The size and shape of the amorphous domain is inferred by fitting the theoretical results to the experimental data. It seems that the layer-like configuration is a poor description for the polyethylene and polypropylene films unless the spatial orientation of the amorphous domain is isotropic. However the spherical configuration is inadequate for Kentucky No. 6 vitrain. The average width b-bar of the amorphous domain is 90—150 A for polyethylene, 20—30 A for uncontinued polypropylene film, and 30—50 A for the conditioned films. The diffusion of magnetization in the amorphous domain of Kentucky No. 6 is faster than that of the polymers, though the dipolar interaction is much weaker in the former. A transfer process due to tranlational motion of small mobile chemical species is suggested.

## 3606 Other Materials

*REFER ALSO TO CITATION(S) 34372, 34372, 34383, 34383, 34384, 34391, 34395, 34532, 34923, 35182, 35196, 35210, 35660*

35218 **(CONF-8106158—1) Interferometric study of epoxy resin gelation.** Hirschbuehler, K.R. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01. Order Number DE81030128.

From Office of Naval Research critical review: techniques for the characterization of composite materials; Cambridge, MA, USA (8 Jun 1981).

The transition of epoxy resins from a mobile liquid to a rubbery gel is a complex process depending on chemical reaction kinetics and both heat and mass transfer. The purpose of this study is to determine the locus of initial gelation in an epoxy resin, and the course of gelatin through both neat resins and glass fiber/epxoy resin composites. This was accomplished by monitoring the local changes in refractive index in transparent epoxy castings using laser interferometry, supplemented by temperature profiles obtained from thermocouple arrays. These experiments were carried out on pure DGEBA epoxy (DOW DER-332) cured with a variety of primary amine, secondary amine, and anhydride curing agents.

35219 **(DOE/ER/01198—1364) Thermal expansion of alkali-graphite intercalation compounds.** Hardcastle, S.E.; Zabel, H. (Illinois Univ., Urbana (USA)). 1981. Contract AC02-76ER01198. 4p. (CONF-810872—3). NTIS, PC A02/MF A01. Order Number DE82000060.

From International conference on phonon physics; Bloomington, IN, USA (30 Aug 1981).

The c-axis thermal expansion of several alkali-graphite intercalation compounds has been measured by means of x-ray scattering between 15 and 300 K. The thermal expansion depends strongly on the stage of the compound and is largest for $C_8M$ (M = K, Rb, Cs) compounds. The data have been analyzed in terms of an one-dimensional quasi-harmonic approximation, which yields Grueneisen parameters two or three times as large as for pristine graphite.

**35220 (DOE/ER/01198—1365) Phonons in alkali graphite intercalation compounds.** Zabel, H.; Magerl, A. (Illinois Univ., Urbana (USA); Institut Max von Laue - Paul Langevin, 38 - Grenoble (France)). 1981. Contract AC02-76ER01198. 4p. (CONF-810872—2). NTIS, PC A02/MF A01. Order Number DE82000059.

From International conference on phonon physics; Bloomington, IN, USA (30 Aug 1981).

The [001]L phonon branches of alkali-graphite intercalation compounds C/sub x/M (x = 8, 24, 36; M = K, Rb, Cs) have been measured by means of inelastic neutron scattering experiments. In all cases the phonon branches show zone folding effects, due to the enlarged unit cell as compared to pristine graphite, along with opening of frequency gaps at the center and boundary of the Brillouin zone. All measured [001]L phonon dispersions are describable by one-dimensional shell models with different masses and force constants to account for the graphite and alkali area-mass densities along the c-axis and their interplanar interactions.

**35221 (DOE/ER/01198—1366) Lattice dynamics of graphite intercalation compounds: modelled by the phonon dispersion of linear chains.** Magerl, A.; Zabel, H. (Illinois Univ., Urbana (USA); Institut Max von Laue - Paul Langevin, 38 - Grenoble (France)). 1981. Contract AC02-76ER01198. 4p. (CONF-810872—4). NTIS, PC A02/MF A01. Order Number DE82000061.

From International conference on phonon physics; Bloomington, IN, USA (30 Aug 1981).

The characteristic features of the phonon dispersion of a monatomic linear chain in a Born-von Karman and a shell model formalism are outlined. Comparing model calculations with measurements of the [001]L phonon dispersion of intercalated graphite, we find that a shell model has to be used for an appropriate description.

**35222 (SAND—81-1487C) Oxidation of polycrystalline boron: the interpretation of AES and ELS results.** Rogers, J.W. Jr.; Knotek, M.L. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 6p. (CONF-811113—13). NTIS, PC A02/MF A01. Order Number DE82000087.

From American Vacuum Society national symposium; Anaheim, CA, USA (3 Nov 1981).

The asymmetrical shape of the high-energy side of the B (KVV) transitions accompanying surface oxidation indicates a superposition of clean and oxide derived features. Two maxima are resolved at 164 and 154 eV; a shoulder is present at 141 eV. ELS loss peaks in oxidized boron are at 4, 8.6, 10.8, 16.7, 23.1, and 36 eV; they are interpreted. (DLC)

**35223 Raman spectroscopic investigation of the structure of silicate glasses. III. Raman intensities and structural units in sodium silicate glasses.** Furukawa, T.; Fox, K.E.; White, W.B. (Materials Research Laboratory, The Pennsylvania State University, University Park, Pennsylvania 16802). *Journal of Chemical Physics ;* **75**: No. 7, 3226-3237(1 Oct 1981).

The Raman scattering intensity of the 1100 $cm^{-1}$ polarized band, which appears on the addition of $Na_2O$ to $SiO_2$ glass, reaches a maximum at the disilicate composition. The intensity of the polarized band at 950 $cm^{-1}$ increases sharply as the $Na_2O$ concentration increases above 30 mole %. These data were interpreted by normal mode calculations and by IR and Raman intensity calculations for the silicate anion structural units: $SiO_4$ isolated tetrahedra, $Si_2O_7$ dimers, $Si_2O_6$ chain links, $Si_2O_5$ sheet units, and $Si_2O_4$ framework units. According to these simplified models, the polarized high frequency band is due to symmetric stretching of Si—$O^-$ nonbridging bonds and the frequency increases with degree of polymerization of the tetrahedra. The previous assignments of the 1100 $cm^{-1}$ band to the symmetric stretch of tetrahedra containing one nonbridging oxygen and of the 950 $cm^{-1}$ band to the symmetric stretch of tetrahedra containing two nonbridging oxygens were confirmed. The other main feature of the alkali silicate glasses, an intense polarized band in the range of 400—600 $cm^{-1}$, was shown to be a mixed stretching bending mode of the Si—O—Si bridging bond. The model also accounts for the loss of intensity of the high frequency band with increasing degree of silica polymerization.

**35224 Density dependence of the light scattering spectrum of fluid nitrogen.** Medina, F.D.; Dugas, J.M. (Department of Physics, Northeastern University, Boston, Massachusetts 02115). *Journal of Chemical Physics ;* **75**: No. 7, 3252-3257(1 Oct 1981).

The light scattering spectrum of fluid nitrogen at 157 K and densities between 120 and 462 amagat was fitted to a third order virial expansion in the density. The one-body intensity contains the unresolved rotational spectrum of the isolated molecules. The two-body intensity contains a rotation—collision cross contribution with a zero integrated intensity, as expected, and a purely collision-induced contribution with the exponential form and decay constant predicted by the model of Bucaro and Litovitz. This latter contribution, unlike all systems previously studied, was found to be negative. The three-body intensity is positive with a shape similar to that of the two-body intensity.

**35225 Tunneling states in methane at high pressures.** Eckert, J.; Fincher, C.R. Jr.; Goldstone, J.A.; Press, W. (Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics ;* **75**: No. 6, 3012-3016(15 Sep 1981).

Rotational tunneling states in phases II and III of solid $CH_4$ were studied by inelastic neutron scattering techniques at 8 K and pressures up to 850 bar. The tunnel energies were found to depend strongly on pressure, while the rotational peak of the disordered molecules shifts little with pressure up to the II—III phase transition. In phase III, additional intensity was found at about 0.18 meV, which we interpret as tunneling states for those molecules that are disordered in phase II.

**35226 Shock compression of liquid carbon monoxide and methane to 90 GPa (900 kbar).** Nellis, W.J.; Ree, F.H.; van Thiel, M.; Mitchell, A.C. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Chemical Physics ;* **75**: No. 6, 3055-3063(15 Sep 1981).

Dynamic equation-of-state data for liquid CO and $CH_4$ were measured in the shock pressure range 5—92 GPa (50—920 kbar) using a two-stage light-gas gun. The liquids were shocked from initial states near their saturation curves at 77 and 111 K for CO and $CH_4$, respectively. The experimental technique used to double-shock $CH_4$ is described. The CO data were examined by using three theoretical models: (1) a chemically nonreactive model, (2) a quasi-chemical-equilibrium model that allows CO to dissociate into gaseous species and graphite, and (3) a chemical-equilibrium model that also includes a dense carbon phase which exists at higher pressures and temperatures than graphite. This dense phase is assumed to be diamond. Our analysis shows that at low pressure chemical equilibrium takes much longer than a typical shock passage time. As a consequence, the experimental data initially follow the nonreactive Hugoniot to pressures well beyond the chemical dissociation limit. Both the experimental data and the Hugoniot computed with case (3) agree satisfactorily at high pressure. Further consequences of these observations to high-explosive studies are discussed. The theoretical analysis for the $CH_4$ data was presented in an earlier paper.

**35227 X-ray diffraction study and models of liquid ethylene at 106 K.** Narten, A.H.; Habenschuss, A. (Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Journal of Chemical Physics ;* **75**: No. 6, 3073-3078(15 Sep 1981).

X-ray diffraction data for liquid ethylene near the melting point are presented. The data are analyzed using scattering factors for —$CH_2$ groups which permits extraction of the intermolecular carbon—carbon structure and distribution functions. Atom pair potentials derived from studies on crystalline hydrocarbons are used with the reference interaction site model (RISM) to predict structure and distribution functions for a dense ethylene-like fluid, and these are compared to the curves derived from the diffraction study. Site—site interaction potentials give an adequate description of liquid ethylene, provided that the attractive forces are averaged over the —$CH_2$ groups with repulsive "bulges" at the hydrogen positions in the $C_2H_4$ molecule. Although —$CH_2$ groups are "seen" by x rays as spherically symmetric, the hydrogen atoms have a sig-

nificant effect on the carbon—carbon correlations in liquid ethylene near the triple point.

35228 **Shear rigidity of spread stearic acid monolayers on water.** Abraham, B.M.; Ketterson, J.B.; Miyano, K.; Kueny, A. (Department of Physics, Technion-Israel Institute of Technology, Haifa, Israel). W-31-109-ENG-38. *Journal of Chemical Physics ;* **75**: No. 6, 3137-3141(15 Sep 1981).

The effect of $Al^{3+}$, $Fe^{3+}$, $Ca^{2+}$, and $Mg^{2+}$ ions and of pH on the two-dimensional shear modulus of stearic acid spread on a water substrate was determined. A large shear modulus was displayed by the films when the subphase contained $Al^{3+}$ and $Fe^{3+}$ ions at the self-buffered pH. With $Fe^{2+}$ dissolved in the subphase, the film displayed a viscous relaxation when strained but no residual stress was observed. No effect was observed with the $Ca^{2+}$ or $Mg^{2+}$. Reducing the pH value in the subphase with the trivalent ions caused the shear modulus to disappear. The observations are interpreted in terms of hydrogen bonding.

35229 **Spatial characteristics of displacement cascades in metals.** Benedek, R. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Journal of Applied Physics ;* **52**: No. 9, 5557-5565(Sep 1981).

The binary-collision simulation code marlowe has been applied to study spatial characteristics of displacement cascades in fcc metals, particularly Cu. Mean densities of vacancies and interstitials <C/sub v/> and <C/sub i/> expressed in terms of radii of gyration of the defect configurations, have been determined as functions of cascade energy. In Cu, <C/sub v/> decreases from $\sim 6 \times 10^{-2}$ to $\sim 4 \times 10^{-4}$ for energies between 1 and 150 keV, whereas <C/sub i/> $\sim 3 \times 10^{-3}$ is roughly constant at energies below 20 keV and approaches <C/sub v/> asymptotically at higher energies. Although <C/sub v/>/<C/sub i/> decreases with energy, the mean vacancy-interstitial separation R/sub i/v is relatively constant. This result supports the classical picture of depleted zones in which increasing numbers of vacancy clusters surrounded by clouds of interstitials are formed as the energy is increased. Perspective plots of the defect configurations in individual cascades presented here also support this picture. Channeling is concluded to have a small effect on <C/sub v/>, but strongly influences the skewness of damage depth profiles. Results are presented for the cascade contraction factor δ. The tendency to form defect clusters and subcascades is discussed.

35230 **Magneto-optical properties of metallic colloids in insulators.** Modine, F.A.; Orera, V.M. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Physical Review [Section] B: Condensed Matter ;* **24**: No. 3, 1159-1163(1 Aug 1981).

Magnetic-circular-dichroism spectra are reported for Na colloids in NaCl and Ca colloids in $CaF_2$. The spectra are interpreted by applying Mie theory and by taking account of the perturbation of the magnetic field. The theory gives a good explanation of the spectra and implies values for cyclotron masses that agree with values predicted for the metallic colloids. Interband contributions to the magnetic circular dichroism are significant for the Ca colloids and unimportant for the Na colloids.

35231 **Neutron scattering investigation of the spin-flop transition in $MnCl_2x4D_2O$.** Butera, R.A.; Corliss, L.M.; Hastings, J.M.; Thomas, R.; Mukamel, D. (Department of Chemistry, University of Pittsburgh, Pittsburgh, Pennsylvania). *Physical Review [Section] B: Condensed Matter ;* **24**: No. 3, 1244-1254(1 Aug 1981).

A detailed study of the spin-flop transition in $MnCl_2x4D_2O$ has been carried out. The characteristics of the first-order "shelf," as determined by neutron scattering, were found to be in good agreement with the phase diagram derived here for the appropriate monoclinic symmetry. Experimental and theoretical analysis of the critical scattering observed at the spin-flop transition close to the bicritical point provide independent confirmation of the first-order nature of the transition.

35232 **Characterization of the magnetic phase transition in cubic β-MnS.** Hastings, J.M.; Corliss, L.M.; Kunnmann, W.; Mukamel, D. (Brookhaven National Laboratory, Department of Chemistry, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter ;* **24**: No. 3, 1388-1390(1 Aug 1981).

The magnetic phase transition in the cubic form of β-MnS has been found to be first order. This result is discussed in relation to proposed magnetic structures as well as to theoretical considerations based on symmetry and on renormalization-group calculations.

35233 **Diffuse x-ray and inelastic neutron scattering study of the spin Peierl's transition in N-methyl-N-ethyl-morpholinium bistetracyanoquinodimethane [MEM-$(TCNQ)_2$].** Van Bodegom, B.; Larson, B.C.; Mook, H.A. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Physical Review [Section] B: Condensed Matter ;* **24**: No. 3, 1520-1523(1 Aug 1981).

X-ray and neutron scattering techniques have been used to investigate the spin Peierl's transition in N-methyl-N-ethyl-morpholinium bistetracyanoquinodimethane [MEM$(TCNQ)_2$]. Both techniques reveal a doubling of the c-axis stacking of the TCNQ molecules below the transition. Diffuse x-ray scattering was observed well above the transition at the position of the low-temperature superlattice reflections. The geometry of the scattering showed that the critical scattering related to the structural changes at T/sub c/ results from fluctuations of a mainly transverse nature. Neutron scattering measurements revealed no softening of longitudinal-acoustic phonons at the transition. It was impossible to determine the position of the transverse-acoustic phonons, because they have either very low energies or very large linewidths; therefore, we cannot define the fluctuations to be of a static or dynamic character.

35234 **Slag and metal oxide vaporization in reactive atmospheres.** Hastie, J.W.; Bonnell, D.W.; Plante, E.R. (National Bureau of Standards, Washington, DC). *High Temperature Science ;* **13**: No. 1, 257-277(1980).

Metal oxides, whether they are present in the form of refractory ceramics or slags, are key components of high temperature energy systems. Planned magnetohydrodynamic (MHD) and coal gasifier systems are particularly dependent on the thermochemical properties of ceramic and slag materials. However, almost no basic thermochemical data exist for oxides in the presence of high temperature-high pressure reactive gases such as $H_2O$. The present study utilizes a modification of the now classical Knudsen effusion mass spectrometric technique and a new technique, transpiration mass spectrometry, for molecular-level thermochemical analysis of MgO and a potassium enriched MHD coal slag in the presence of $H_2O$ vapor and related gases. New data are presented for the enthalpy of formation of MgOH (ΔH/sub f,298/ = -35.8 +- 3.0 kcal/mol). Species partial pressures and derived activity coefficients are given for a potassium enriched Illinois number 6 coal slag over a range of $K_2O$ content (15.4 to 8.0 mol %) and temperature (1100 to 1820°K). Data on the effect of $H_2O$ vapor on alkali vapor transport are also given.

# 40 CHEMISTRY

## 4001 Analytical And Separations Chemistry

*REFER ALSO TO CITATION(S) 34224, 34318, 34323, 34334, 34335, 34336, 34338, 34339, 34340, 34357, 34403, 35184, 35291, 35436, 35463, 35489*

35235 **(DOE/ER/04535—8) Solvent extraction studies using high-molecular-weight amines.** McDonald, C. (Texas Southern Univ., Houston (USA). Dept. of Chemistry). 25 Aug 1981. Contract AS05-76ER04535. 4p. NTIS, PC A02/MF A01. Order Number DE81030061.

This research project is concerned with systematically investigating high-molecular-weight amines and high-molecular-weight quaternary ammonium salts to ascertain the feasibility of their utilization for the extraction of group II B and transition metal ions from aqueous solutions. Methods which have promise of being

scaled up for utilization by industries for the economical removal of toxic metal such as mercury, cadmium and nickel from their effluent waste water are being investigated. During this contract period, the following two research projects were completed: solvent extraction of mercury using alamine 304; and ion flotation of nickel using ethylhexadecyldimethylammonium bromide.

35236 **(DOE/EV/10240—T1) Synchronous fluorescence/ matrix isolation method for trace organic analysis. Progress report, July 1980-July 1981.** Pardue, H.L. (Purdue Univ., Lafayette, IN (USA). Dept. of Chemistry). 1981. Contract AC02-79EV10240. 5p. NTIS, PC A02/MF A01. Order Number DE81030958.

The first phase of the project involved assembling the instrumentation, constructing the computer interface, writing computer software, and preliminary testing. The principal components of the system are a high intensity Xenon arc lamp for excitation, two flat field f/4 spectrographs (J-4 Model UFS-2000) for dispersion of excitation and emission spectra, fused silica cuvette, an image dissector camera system (EMR Photoelectric 658A) for detection of emission intensity, a custom designed and constructed computer interface for scan control and data acquisition, and PDP-8 computer with assorted peripherals. Preliminary data indicate a range of at least 400 nm can be resolved to about 1 nm for both excitation and emission spectra. Computer interface and software are designed to permit any one of three modes of operation, namely a) the diagonal scans required to generate synchronous fluorescence spectra directly, b) random access to any set of excitation/emission coordinates, and c) total scans of any selected area (up to 100%) of the complete set of excitation/emission coordinates. The complete system became operational in late 1980 and we have been evaluating the system since that time. Data for anthracene are presented here to illustrate system response.

35237 **(K—2026) Development of elemental analyzer to programmable calculator interface.** Postma, F.W. Jr. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Sep 1981. Contract W-7405-ENG-26. 58p. NTIS, PC A04/MF A01. Order Number DE82000895.

A solid state electronic interface was designed and constructed. It relieved the analyst of the responsibility for measuring changes in the pen position on the strip chart and for performing the calculations during the analysis and weighting period. A program was written to calculate blanks, standard factors, and sample weight fractions for nitrogen, carbon, and hydrogen. The interface passed data from a Perkin-Elmer Elemental Analyzer to a Texas Instruments TI Programmable 59 pocket calculator and printer.

35238 **(LA-UR—81-2533) Applications of DHDECMP extraction chromatography to nuclear analytical chemistry.** Marsh, S.F.; Simi, O.R. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 10p. (CONF-811025—1). NTIS, PC A02/MF A01. Order Number DE81030134.

From 25. conference on analytical chemistry and nuclear technology; Gatlinburg, TN, USA (6 Oct 1981).

Dihexyl-N,N-diethylcarbamylmethylenephosphonate (DHDECMP) is a highly selective extractant for actinides and lanthanides. This reagent, extensively studied for process-scale operations, also has valuable analytical applications. Extraction chromatographic columns of DHDECMP, supported on inert, porous, polymer beads effectively separate most metallic impurity elements from the retained inner transition elements. The retained elements can be separated into individual fractions of (1) lanthanides, (2) americium, (3) plutonium, and (4) uranium by mixed-solvent anion exchange.

35239 **(NBL—298) Quantitative ion-exchange separation of plutonium from impurities.** Pietri, C.E.; Freeman, B.P.; Weiss, J.R. (Department of Energy, Argonne, IL (USA). New Brunswick Lab.). Sep 1981. 96p. NTIS, PC A05/MF A01. Order Number DE82000819.

The methods used at the New Brunswick Laboratory for the quantitative ion exchange separation of plutonium from impurities prior to plutonium assay are described. Other ion exchange separation procedures for impurity determination and for isotopic abundance measurements are given. The primary technique used consists of sorption of plutonium(IV) in 8N $HNO_3$ on Dowex-1 anion exchange resin and elution of the purified plutonium with 0.3N HCl-0.01N HF. Other methods consist of the anion exchange separation of plutonium(IV) in 12N HCl and the cation exchange separation of plutonium(III) in 0.2 N $HNO_3$. The application of these procedures to the subsequent assay of plutonium, isotopic analysis, and impurity determination is described.

35240 **(ORNL/MIT—329) Fundamental studies in continuous annular chromatography.** Torres, R.J.; Chang, C.S.; Epstein, H.A. (Oak Ridge National Lab., TN (USA); Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice). Sep 1981. Contract W-7405-ENG-26. 96p. NTIS, PC A05/MF A01. Order Number DE82000519.

The effects on separation performance of bed-rotation rate, bed loading, and feed concentrations were investigated using a pressurized continuous chromatograph. Ion-exchange chromatography was used to separate $[Ni(NH_3)$/sub 6-x/$(H_2O)$/sub x/$]^{2+}$, $[Co(NH_3)_4CO_3]^+$, and $[Co(NH_3)_5CO_3]^+$ with 1.6 M $(NH_4)_2CO_3$ of pH 9.0 as eluant. The experimental results were compared with predictions of plate theory and with a theoretical multicomponent chromatography model developed by Rhee. Experimentally observed band positions are accurately predicted by both models in the low feed concentration region but only by the Rhee model in the high concentration region. The experimentally determined bandwidths, however, are underestimated by both models, but more severely for the cobalt complexes by the Rhee model which does not allow dispersion. A correction to the experimental bandwidths was necessary to account for the discrete nature of the sampling.

35241 **(ORNL/TM—7925) Performance of a large hyperpure germanium detector array for in-vivo detection of low-energy photon and x-ray emitters: analytical procedure and current capabilities.** Berger, C.D.; Lane, B.H. (Oak Ridge National Lab., TN (USA)). Oct 1981. Contract W-7405-ENG-26. 23p. NTIS, PC A02/MF A01. Order Number DE82000443.

The ORNL Whole Body Counter is one of the few in the country that is capable of assessment of body burdens of low-energy photon and x-ray emitters. This requires detectors and electronics specific for the task. Isotope identification and quantification capabilities are crucial at the facilities which deal with quantities of many radionuclides. The standard procedure for whole counting done at ORNL employs a 13.34 cm-dia. phoswich, a hyperpure germanium (HPGe) array consisting of six detectors totaling 80 $cm^2$, and a 23 cm by 23 cm NaI detector positioned under the subject's back. Isotope identification and quantification capabilities for detection of the actinides using the HPGe array are greatly improved over the phoswich system, making the HPGe detector an integral part of lung counting operations at ORNL. The HPGe array has been fully operational since May 1980. Since that time, calibrations have been performed with various sources, a calibration curve derived, and minimum significant measured activity (MSMA) and minimum detectable true activity (MDTA) for various radionuclides have been determined. The current analysis techniques are discussed, examples of MSMA and MDTA for various isotopes are given, and the derivation of a universal calibration curve for preliminary estimation of body burden is discussed using data acquired by the HPGe array.

35242 **Quantitation of fluorophores in solution by pulsed laser excitation and time-filtered detection.** Haugen, G.R. (Lawrence Livermore Lab., CA); Lytle, F.E. Contract W-7405-ENG-48. *Analytical Chemistry ;* **53**: No. 11, 1554-1559(Sep 1981).

A fluorimeter employing single photon counting and mode-locked laser excitation was constructed to test the concept of time-filtered detection. Expressions for a figure of merit and a signal-to-noise ratio are developed and utilized with experimental data to gain an understanding of operational principles. Other data are examined to ascertain calibration curve characteristics. The usable linear dynamic range is about 3 orders of magnitude, the sensitivity is $2 \times 10^{13}$ counts $M^{-1} s^{-1}$, and the lower limit of detection (S/N = 2) is $1.8 \times 10^{-13}$ M for a 100-s counting period. Finally, future in-

strumental advances are discussed that should allow better than an order of magnitude improvement in the lower limit of detection.

**35243 Liquid chromatography-mass spectrometry with electron impact and fast ion bombardment with a ribbon storage interface.** Smith, R.D.; Burger, J.E.; Johnson, A.L. (Pacific Northwest Lab., Richland, WA). Contract AC06-76RLO1830. *Analytical Chemistry ;* **53**: No. 11, 1603-1611(Sep 1981).

The design and performance of a new moving ribbon liquid chromatograph-mass spectrometer interface for use with secondary ion mass spectrometry (SIMS) and conventional electron impact ionizaton (EI) are described and initial results are presented. The interface includes a 120 cm long region at atmospheric pressure and aerosol deposition of the LC effluent to allow the complete evaporation of the LC mobile phase before the first vacuum slit and a 320 cm total ribbon length to allow the storage of chromatographically separated materials. Detection limits for several amino several amino acids of $< 10^{-11}$ g have been demonstrated. The long ribbon also allows the temporary storage of 5 to 60 min HPLC separations on the ribbon for subsequent reanalysis by SIMS or EI (at several temperatures) and has been demonstrated for amino acids using SIMS and complex samples using electron impact. Surface damage using SIMS due to high primary ion currents was found to be limited by the short exposure time under typical conditions. A new method for ribbon cleaning using vapor deposition of a thin layer of silver is also described which reduces background from contaminants and residue on the ribbon and is superior to heaters or solvent baths for ribbon cleaning. The approach to the data acquisition, potential artifacts related to surface damage, and initial attempts at quantitation are described.

**35244 Chemical class separation and characterization of organic compounds in synthetic fuels.** Later, D.W.; Lee, M.L.; Bartle, K.D.; Kong, R.C.; Vassilaros, D.L. (Brigham Young Univ., Provo, UT). Contract AC02-79EV10237. *Analytical Chemistry ;* **53**: No. 11, 1612-1620(Sep 1981).

A separation method is described for the identification of organic compounds in synthetic fuel products. Prefractionation of crude synfuel materials into discrete chemical classes was prformed by adsorption column chromatography using small quantities of neutral aluminum oxide and silicic acid. Subsequent high-resolution separation of individual components was achieved by using capillary column gas chromatography, and specific compound types were determined by gas chromatographic retention data and combined gas chromatography-mass spectrometry. The principal chemical classes investigated in a solvent-refined coal liquid were aliphatic hydrocarbons, polycyclic aromatic hydrocarbons, polycyclic aromatic sulfur heterocycles nitrogen polycyclic aromatic compounds, and hydroxyl polycyclic aromatic hydrocarbons. The nitrogen-containing aromatic compounds were further separated into secondary nitrogen polycyclic aromatic heterocycles, amino polycyclic aromatic hydrocarbons, and tertiary nitrogen polycyclic aromatic heterocycles to facilitate their identification.

**35245 Single-column ion chromatography for the determination of chloride and sulfate in steam condensate and boiler feed water.** Roberts, K.M. (AECI Ltd., Transvaal, South Africa); Gjerde, D.T.; Fritz, J.S. Contract W-7405-ENG-82. *Analytical Chemistry ;* **53**: No. 11, 1691-1695(Sep 1981).

An effective analytical method is described for determination of parts-per-billion concentrations of chloride and sulfate in very pure water such as steam condensates. Sample anions are concentrated on a short precolumn, separated on an anion-exchange column of very low capacity, and detected by an electrical conductivity detector placed immediately after the separation column. No suppressor column is employed. Chloride and sulfate can be determined at concentrations as low as 1 to 2 ppB in the water samples. Several real water samples have been analyzed successfully by the new procedure.

**35246 Extraction of $UO_2$2i by two hindered (GO)($ClCH_2$)PO(OH) extractants, in benzene and n-heptane diluents, from aqueous chloride and nitrate phases.** Mason, G.W.; Coppola, P.J.; Lewey, S.M.; Hayes, J.S.; Peppard, D.F. (Argonne National Lab., IL (USA)). *Journal of Inorganic and Nuclear Chemistry ;* **43**: No. 5, 1041-1044(1981).

The extraction of U(VI) from an aqueous mineral acid phase by a hindered (GO)($ClCH_2$)PO(OH) extractant in a carrier diluent was studied as a function of the hydrogen ion concentration in the aqueous phase, steric hindrance within the extractant molecule, nature of the carrier diluent and composition of the aqueous phase. The reactants are specified, and experimental details given. The results are presented and discussed.

**35247 Applications of laser-induced fluorometry to the analysis of ultratrace levels of uranium in an industrial environment.** Hinton, E.R. Jr.; White, L.E. (Union Carbide Corp., Oak Ridge, TN). Contract W-7405-ENG-26. *Analytical Letters ;* **14**: No. A12, 947-958(1981).

Laser-induced fluorometric analysis of ultratrace levels of uranium in industrial environmental samples is compared with commonly used spectroscopic techniques for uranium analysis.

## 4002 Inorganic And Physical Chemistry

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**35248 (CONF-810953—2) Aqueous dissolution of calcium metaphosphate glasses.** Bunker, B.C. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00656. 9p. NTIS, PC A02/MF A01. Order Number DE81030130.

From JOWOG-12 conference; Aldermaston, UK (21 Sep 1981).

A series of experiments was conducted to determine the kinetics and mechanisms of aqueous dissolution for a series of phosphate glasses having the mole % composition (50-X)$M_2O$.X$CaO$.5$OP_2O_5$, where M is either Na or Li. 9 figures.

**35249 (DOE/ER/10346—T1) Fundamental studies in isotope chemistry. Progress report, 1 October 1980-1 August 1981.** Bigeleisen, J. (State Univ. of New York, Albany (USA). Research Foundation). 1981. Contract AC02-79ER10346. 25p. NTIS, PC A02/MF A01. Order Number DE82000651.

The current program, as in the past, utilizes theoretical advances made specifically with respect to isotope chemistry in the study of the structure of matter. Experimental investigation using isotope effects provides a unique tool for the determination of the mean square force on an atom in a molecule and how it is affected by intermolecular forces. We have completed the systematic study of the isotope chemistry of hydrogen. Studies have been made of the isotopic reduced partition function ratio, (s/s')f, of thirty-nine diatomic and nineteen polyatomic hydrides. It encompasses compounds of hydrogen with every element in each row and each column of the periodic table. This progress report also includes a description of our final design for sampling a cryogenic liquid. Such a sampler is necessary if we are to realize the full potential of the isotopic fractionation method to study the mean square forces and torques in polyatomic liquids.

**35250 (DOE/ER/10689—1) Reactions of metal ions and their clusters in the gas phase using laser ionization: ion cyclotron resonance spectroscopy.** Freiser, B.S. (Purdue Univ., Lafayette, IN (USA)). Apr 1981. Contract AC02-80ER10689. 31p. (CONF-810548—8). NTIS, PC A03/MF A01. Order Number DE81029015.

From 29. annual conference on mass spectrometry; Minneapolis, MN, USA (24 May 1981).

Two subjects are discussed in this report: advances in proposed studies on metal ion chemistry and expansion of laboratory facilities. The development of a combined pulsed laser source-ion cyclotron resonance spectrometer has proven to be a convenient and powerful method for generating metal ions and for studying their subsequent chemistry in the gas phase. The main emphasis of this research has been on the application of metal ions as a selective chemical ionization reagents and progress in this area are discussed. The goal is to identify trends in reactivity i.e. mechanisms useful in interpreting the chemical ionization spectra of unknown compounds and to test for the functional group selectivity of the various metal ions. The feasibility of these goals have been demonstrated in exten-

sive studies on $Cu^+$ with esters and ketones, on $Fe^+$ with ethers, ketones, and hydrocarbons, and on $Ti^+$ with hydrocarbons. In addition, preliminary results on sulfur containing compounds and on a variety of other metallic ions have been obtained. Laboratory facilities were expanded from one ion cyclotron resonance (ICR) spectrometer to two, plus a third instrument the Fourier Transform Ion Cyclotron Resonance (FTICR) spectrometer.

**35251 Thermodynamic properties of tricesium chromium(V) tetroxide ($Cs_3CrO_4$).** Kim, K.Y.; Johnson, G.K.; Johnson, C.E.; Flotow, H.E.; Appelman, E.H.; O'Hare, P.A.G. (Argonne National Lab., IL (USA)); Phillips, B.A. (UKAEA Atomic Energy Research Establishment, Harwell. Chemical Technology Div.). *Journal of Chemical Thermodynamics ;* **13**: No. 4, 333-344(Apr 1981).

Low-temperature and solution-calorimetric investigations of $Cs_3CrO_4$ have yielded values for the following thermodynamic properties at T = 298.15 K: S°, C°sub(p), -(G°(T) - H°(0))/T, (H°(T) - H°(0)) and Δ H°sub(f). An unusual feature of the solution calorimetry was the use of aqueous xenon trioxide, $XeO_3$(aq), as oxidant. High-temperature drop calorimetry revealed a solid-to-solid ($\beta$-to-gamma) transition at 774 K with ΔHsub(tr) = 1.8 kJ $mol^{-1}$ and ΔSsub(tr) = 2.3 J $K^{-1}$ $mol^{-1}$. Expressions are presented for the enthalpy increment as a function of temperature (a) below, and (b) above, the transition temperature. A table of thermodynamic functions to 1000 K is given.

**35252 (Y/DK--264) Sorption analyses in materials science: selected oxides.** Fuller, E.L. Jr.; Condon, J.B.; Eager, M.H.; Jones, L.L. (Oak Ridge Y-12 Plant, TN (USA)). 17 Aug 1981. Contract W-7405-ENG-26. 167p. NTIS, PC A08/MF A01. Order Number DE82000135.

Physical adsorption studies have been shown to be extremely valuable in studying the chemistry and structure of dispersed materials. Many processes rely on the access to the large amount of surface made available by the high degree of dispersion. Conversely, there are many applications where consolidation of the dispersed solids is required. Several systems (silica gel, alumina catalysts, mineralogic alumino-silicates, and yttrium oxide plasters) have been studied to show the type and amount of chemical and structural information that can be obtained. Some review of current theories is given and additional concepts are developed based on statistical and thermodynamic arguments. The results are applied to sorption data to show that detailed sorption analyses are extremely useful and can provide valuable information that is difficult to obtain by any other means. Considerable emphasis has been placed on data analyses and interpretation of a nonclassical nature to show the potential of such studies that is often not recognized nor utilized.

**35253 Generalized resonating valence bond method: Barrier heights in the HF + D and HCl + D exchange reactions.** Voter, A.F.; Goddard, W.A. III. (Arthur Amos Noyes Laboratory of Chemical Physics California Institute of Technology, Pasadena, California 91125). DE-AC03-765SF00767. *Journal of Chemical Physics ;* **75**: No. 7, 3638-3639(1 Oct 1981).

A method of self-consistent optimization of a resonating wave fuction is developed and applied to the reaction HF+Darrow-right-leftH+FD. (AIP)

**35254 Kinetic isotope effect in the heterogeneous reaction of graphite with $H_2O$ ($D_2O$).** Yates, J.T. Jr.; McKee, D.W. (Surface Science Division, National Bureau of Standards, Washington, D. C. 20234). *Journal of Chemical Physics ;* **75**: No. 6, 2711-2714(15 Sep 1981).

Thermogravimetric studies have been carried out for the reaction of $H_2O$ ($D_2O$) with pure graphite surfaces and with graphite surfaces containing $BaCO_3$ catalyst. At temperatures near 1200 K the kinetic isotope effect has been measured to be about a factor of 2 for both pure graphite and $BaCO_3$—graphite. This value of the ratio of rates for $H_2O$ compared to $D_2O$ is consistent with zero point energy differences between the two isotopic reactants, and suggests that the transition state in the rate determining step involves a complex in which an O—H bond is being broken. The similarity of the magnitude of the isotope effect for both the catalyzed and the uncatalyzed reaction suggests that in both cases a similar O—H bond breaking mechanism is operative in the rate determining step.

**35255 Flexible d basis sets for Sc through Cu.** Rappe, A.K.; Smedley, T.A.; Goddard, W.A. III. (California Inst. of Tech., Pasadena). Contract EX-76-G-03-1305. *Journal of Physical Chemistry ;* **85**: No. 18, 2607-2611(3 Sep 1981).

A prescription is presented and implemented for Sc through Cu that leads to practical-sized Gaussian d basis sets capable of accurate descriptions of the s/sup m/d/sup n-m/ states of the atom. Optimized Gaussian basis sets containing four, five, and six primitives are given along with recommended double zeta, double zeta, and triple zeta contraction schemes, respectively. It is suggested that these basis sets be used for calculations on large, medium, and small transition metal complexes, respectively.

**35256 Preparation of some dithiocarbene complexes, $W(CO)_5[C(SR)_2]$, and their reactions with nucleophiles.** Pickering, R.A.; Angelici, R.J. (Ames Lab., IA). Contract W-7405-ENG-82; WPAS-KC-03-02-01. *Inorganic Chemistry ;* **20**: No. 9, 2977-2983(Sep 1981).

The reaction of $W(CO)_5CS$ with $^-SR$ (R = $CH_3$, $C_2H_5$, i-$C_3H_7$, n-$C_4H_9$, or t-$C_4H_9$) followed by alkylation of the resulting dithioester anion, $W(CO)_5[C(=S)SR]^-$, by R'I(R' = $CH_3$ or $C_2H_5$) produces [bis(alkylthio)carbene]tungsten complexes, $W(CO)_5[C(SR)(SR')]$, in good yield. The substituted tetracarbonyl[bis(methylthio)carbene]tungsten complexes cis-$W(CO)_4[P(OCH_3)_3][C(SCH_3)_2]$ and cis-$W(CO)_4[P(OPh)_3](C(SCH_3)_2]$ are prepared by an analogous route using cis-W-$(CO)_4L(CS)$, where L = $P(OCH_3)_3$ or $P(OPh)_3$. (Cyclic dithiocarbene)tungsten complexes may be prepared in a similar manner from $W(CO)_5CS$, $NaS(CH_2)$/sub n/SH (n = 2, 3, 4), and $CH_3I$ to give $W(CO)_5CS(CH_2)$/sub n/S. The carbene complex $W(CO)_5(SCH_3)[SFe(CO)_2Cp]$ (Cp = eta$^5$-$C_5H_5$) is prepared by the reaction of $W(CO)_5[C(=S)(SCH_3)]^-$ with $CpFe(CO)_2(THF)^+$. Isocyanide complexes, $W(CO)_5CN$-R, are formed when $W(CO)_5[C(SCH_3)_2]$ reacts with primary amines, $RNH_2$, where R = $CH_3$, $(CH_2)_2CH_3$, $CH_2Ph$, $C_6H_{11}$, and $(CH_2)_2N(CH_3)_2$, or the diamine $NH_2(CH_2)_3NH_2$. When cis-$W(CO)_4[P(OPh)_3][C(SCH_3)_2]$ is reacted with $NH_2CH_2Ph$ and $NH_2(CH_2)_3NH_2$, isocyanide complexes are also formed. The reaction of $W(CO)_5[C(SCH_3)_2]$ with secondary amines $NH(CH_3)_2$, $HN(CH_2)_2OCH_2CH_2$, or $HN(CH_2)_4CH_2$ yields (aminothiocarbene)tungsten complexes, $W(CO)_5[C(SCH_3)NR_2]$. The compound $[N(C_2H_5)_4^+][W(CO)_5CN^-]$ was formed from the reaction of $W(CO)_5[C(SCH_3)_2]$ with $[N(C_2H_5)_4^+][N_3^-]$.

**35257 Reactions of (eta$^5$-cyclopentadienyl)cobalt(III) alkyls with cobalt(I) phosphines and iron carbonyls. Evidence for direct eta$^5$-cyclopentadienyl and trimethylphosphine group transfer between metal centers.** Bryndza, H.E.; Bergman, R.G. (Lawrence Berkeley Lab., CA). Contract W-7405-ENG-48. *Inorganic Chemistry ;* **20**: No. 9, 2988-2991(Sep 1981).

We have found that (eta$^5$-methylcyclopentadienyl)(triphenylphosphine)dimethylcobalt(III) undergoes intermolecular cyclopentadienyl ligand exchange with (eta$^5$-cyclopentadienyl)bis(triphenylphosphine)cobalt. The unsubstituted cyclopentadienyl(triphenylphosphine)dimethylcobalt(III) reacts in two different types of processes, with both $Fe_2(CO)_9$ and $Fe(CO)_5$. The first involves electrophilic displacement of coordinated phosphine by unsaturated $Fe(CO)_4$, and the second takes place by abstraction of CO from $Fe(CO)_5$ by the unsaturated $CpCoMe_2$ fragment (generated by phosphine dissociation from the saturated starting material).

**35258 Methylene-bridged metal-metal bond: neutron diffraction study of ($\mu$-$CH_2$)[eta$^5$-$C_5H_5$)Rh(CO)]$_2$ at 15 K.** Takusagawa, F. (Brookhaven National Lab., Upton, NY); Fumagalli, A.; Koetzle, T.F.; Herrmann, W.A. *Inorganic Chemistry ;* **20**: No. 9, 3060-3064(Sep 1981).

A low-temperature neutron diffraction study of ($\mu$-$CH_2$)[(eta$^5$-$C_5H_5$)Rh(CO)]$_2$ has been carried out in order to determine the geometry of the bridging methylene group with high precision. The mean methylene C-H bond distance is found to be 1.095 (1) A, and the H-C-H angle of 110.4 (1)° lies near the tetrahedral

value. The dihedral angle between the $CH_2$ and $Rh_2C$ planes is 84.1°. The cyclopentadienyl ligands are slightly distorted from an ideal pentagonal shape, reflecting the influence of the coordination about rhodium on the five-membered rings. There is no systematic displacement of the hydrogen atoms from the planes of the rings, with respect to the rhodium atom positions. Crystallographic data: space group P1, Z = 2, a = 7.857 (2) A, b = 8.914 (2) A, c = 9.319 (2) A, $\alpha$ = 74.21 (2)°, $\beta$ = 81.25 (1)°, $\gamma$ = 82.56 (2)°, T = 15 K. The final unweighted R value based on $F^2$ for 3054 reflections ($(\sin\theta)/\lambda < 0.70$ $A^{-1}$) is 0.036.

**35259 Lanthanum monochloride and lanthanum sesquichloride.** Araujo, R.E.; Corbett, J.D. (Ames Lab., IA). Contract W-7405-ENG-82; WPAS-KC-02-03. *Inorganic Chemistry ;* **20**: No. 9, 3082-3086(Sep 1981).

Synthesis of LaCl from La and $LaCl_3$ in nearly quantitative yield is attained with powdered La (from LaH/sub x/) and 30-day equilibration periods at 745 to 820°C provided either the $LaCl_3$ is first fused to provide intimate contact with the excess La or the reactants in stoichiometric proportions are pressed to ~ 1000 atm within the welded Ta container prior to reaction. Negligible yields are obtained with La sheet. Data from a single-crystal refinement of the LaCl structure (ZrBr type) are reported (R3m; a = 4.1026 (6) A, c = 27.597 (6) A; R = 0.086; 150 independent reflections with $\theta\theta < 55°$). LaCl decomposes peritectically at 825 to 826°C, close to the eutectic temperature of the binary $LaCl_3$-La system. Needles of $La_2Cl_3$($Gd_2Cl_3$ type) are also formed in incomplete reactions (a = 15.890 (9) A, b = 4.404 (2) A, c = 10.231 (9) A, $\beta$ = 119.14 (7)°). The La-La distances in these phases are quite large in comparison with those known for analogous yttrium and terbium phases, and the Pauling bond orders per electron pair summed over all independent distances give a similar picture (LaCl 0.49 vs YCl 0.94). The large distances and reduced bonding in the expanded La-La arrays relative to the metal may arise from a loss of the significant 4f contribution which has been proposed for the pure metal.

**35260 Kinetics and equilibrium of complexation of iron(III) ions by methylaquorhodoxime.** Espenson, J.H.; McHatton, R.C. (Ames Lab., IA). Contract W-7405-ENG-82. *Inorganic Chemistry ;* **20**: No. 9, 3090-3092(Sep 1981).

The species referred to in the title react reversibly to form $[CH_3Rh((dmg)_2HFe)H_2O]^{2+}$ in which one O-H--O unit has been replaced by O-Fe-O according to the equilibrium $CH_3Rh(dmgH)_2H_2O + Fe^{3+} \rightarrow A + H^+$. The equilibrium constant is 68.8 +- 4.0 (in water at 25.0°C), with due allowance for the protonation equilibrium $CH_3Rh(dmgH)_2H_2O + H^+ \rightarrow CH_3Rh((dmg)_2H_3)H_2O^+$ (K = 5.66 $M^{-1}$). The rate law for the forward reaction is d[A]/dt = (k/sub 1f/ + k/sub 2f//[$H^+$])[$CH_3Rh(dmgH)_2H_2O$][$Fe^{3+}$] with k/sub 1f/ = 2.08 +- 0.06 $M^{-1}s^{-1}$ and k/sub 2f/ = 0.620 +- 0.010 $s^{-1}$. The reaction proceeds by parallel paths, in which it is proposed that the mechanism consists of neutralization of the hydrogen-bonded proton of O-H--O by $(H_2O)_5FeOH^{2+}$, as a result of which iron(III) is substituted in its place and an O-Fe-O unit is incorporated into the rhodoxime.

**35261 Moessbauer spectroscopic study of passivated small particles of iron and iron carbide.** Amelse, J.A.; Grynkewich, G.; Butt, J.B.; Schwartz, L.H. (Northwestern Univ., Evanston, IL). Contract AC02-78ERO4993. *Journal of Physical Chemistry ;* **85**: No. 17, 2484-2488(20 Aug 1981).

Moessbauer spectra have been recorded at room, liquid-$N_2$, and liquid-He temperatures for iron supported on silica after calcination, reduction, and carburization. Passivation, i.e., exposure to air, of reduced iron resulted in partial oxidation to $\beta$-FeOOH. Carburization at 300°C in $3H_2$:CO produced a mixture of chi-$Fe_5C_2$ and $\epsilon'$-$Fe_{2\ 2}C$ in agreement with previous workers. Passivation of these carbides resulted in partial oxidation to either $\gamma$-FeOOH or an amorphous iron gel. These experiments emphasize the great potential for error if the study of these materials is confined to room-temperature spectra.

**35262 Laser intensity induced nonradiative processes in molecules.** Needham, C.; Rhodes, W. (Florida State Univ., Tallahassee). Contract AS05-78EV05784. *Journal of Physical Chemistry ;* **85**: No. 17, 2535-2542(20 Aug 1981).

The effects of the coupling strength (i.e., the Rabi frequency) of a coherent radiation mode interacting with a multilevel molecule are considered. A doorway-state basis is used in which the radiative doorway state, carrying all of the radiative interaction strength from the ground (initial) state, is coupled by intramolecular (nonradiative) interaction to other excited states. The resulting coupling scheme involves an effective Hamiltonian formulation in an extended rotating basis. Quantitative results from the theory are obtained by computer simulation. It is shown how variation of the laser coupling strength can modify the dynamics of nonradiative transitions, thereby producing: (1) decoupling of radiationless decay; (2) enhancement of radiationless decay; (3) selectivity of photophysical and photochemical processes; or (4) laser-induced isolation of states, depending on the conditions of the system. The case of two states coupled through a common manifold of states and the conditions for biexponential decay are also considered.

**35263 Determination of ir extinction coefficients for linear- and bridged-bonded CO on supported palladium.** Vannice, M.A.; Wang, S.Y. (Pennsylvania State Univ., University Park). Contract EG-77-S-02-4463. *Journal of Physical Chemistry ;* **85**: No. 17, 2543-2546(20 Aug 1981).

Infrared spectra were obtained of CO adsorber on Pd dispersed on four supports: eta-$Al_2O_3$, $SiO_2$, $SiO_2$-$Al_2O_3$, and $TiO_2$. All catalysts were characterized by both $H_2$ and CO chemisorption which allowed the calculation of the surface coverages of both linearly adsorbed CO, which gives a band above 2000 $cm^{-1}$, and the bridged-bonded form, which produces a band below 2000 $cm^{-1}$. From these values, integrated absorbances, A, and extinction coefficients, $\epsilon$, have been determined for each adsorbed species on Pd for the first time. For individual catalysts, absorbances and extinction coefficients were always much higher for the bridged-bonded CO than the linearly adsorbed CO, i.e., average values were A/sub b/ = 85 x $10^7$ cm $mol^{-1}$, $A_1$ = 3.3 x $10^7$ cm $mol^{-1}$, $\epsilon$/sub b/ = 4.1 x $10^6$ $cm^2$ $mol^{-1}$, and $\epsilon_1$ = 0.36 x $10^6$ $cm^2$ $mol^{-1}$. Because a specially designed ir reactor cell was utilized, spectra were also taken under steady-state CO hydrogenation reaction conditions to form $CH_4$. The $Al_2O_3$-, $SiO_2$-, and $SiO_2$-$Al_2O_3$-supported Pd catalysts still exhibited strong CO bands; however, Pd/$TiO_2$ wafers exhibiting SMSI (strong metal-support interactions) showed no detectable CO bands although they were the most active catalyst. Using the $\epsilon$ values obtained in this study, we estimated the maximum surface coverage on Pd to be less than 1% for the linear species and 0.1% for the bridged species.

**35264 Kinetics of the reaction between hydroxylamine and sodium bisulfite.** Gomiscek, S.; Clem, R.; Novakov, T.; Chang, S.G. (Lawrence Berkeley Lab., CA). Contract W-7405-ENG-48. *Journal of Physical Chemistry ;* **85**: No. 17, 2567-2569(20 Aug 1981).

Hydroxylamine and sulfur dioxide react in aqueous solution to form either sulfamic acid or ammonium bisulfate. Rate studies have been performed as a function of temperature. The rate law has been determined. The enthalpy and entropy of activation for the formation of both sulfamic acid and ammonium bisulfate have been evaluated.

**35265 Synthesis, characterization, and reactions of iron-sulfur clusters containing the $S_2$ ligand: [$Cp_2Fe_2(S_2)(SR)_2$]/sup 0,1+/, [$Cp_4Fe_4S_5$]/sup 0,1+,2+/, and [$Cp_4Fe_4S_6$].** Kubas, G.J.; Vergamini, P.J. (Los Alamos National Lab., NM). *Inorganic Chemistry ;* **20**: No. 8, 2667-2676(Aug 1981).

Syntheses of the following disulfide-containing dinuclear and tetranuclear organoiron compounds are described: [$Cp_2Fe_2(S_2)(SR)_2$]/sup 0,1+/, [$Cp_4Fe_4S_5$]/sup 0,1+,2+/, and [$Cp_4Fe_4S_6$] (Cp = eta$^5$-$C_5H_5$). The compounds have been characterized by spectroscopic, electrochemical, and chemical properties. Temperature-dependent $^1$H NMR spectroscopy indicates fluxionality of the triply bridging disulfide ligand in $Cp_4Fe_4S_5$/sup n/ (n = 0 and 2+). The cluster products resulting when these disulfide-containing complexes are chemically or electrochemically oxidized, including $[CpFe(SR)(NCMe)]_2^{2+}$, and adducts formed with other metals via the electron-rich disulfide ligands are discussed.

**35266 Electron paramagnetic resonance spectra of erbium(III), dysprosium(III), and gadolinium(III) in yttrium and lanthanum hydrides.** Spencer, B.; Edelstein, N.M. (Lawrence Berkeley Lab., CA). Contract W-7405-ENG-48. *Inorganic Chemistry ;* **20**: No. 8, 2736-2737(Aug 1981).

The present study was undertaken to confirm the oxidation state of the metal and the hydridic nature of the hydrogen by obtaining electron paramagnetic resonance (EPR) parameters sensitive to the oxidation state of the metal and to the sign of the charge on the hydrogen for representative lanthanides (Er, Dy, and Gd) diluted in the nonmagnetic host materials YH/sub x/ and LaH/sub x/. For hydride compositions near x = 2.0, the environment of the dopant metal ion should be cubic for the majority of the ions present, thus providing a convenient situation for determining the oxidation state and electronic ground state of the ion in question so as to distinguish between protonic and hydridic crystalline electric fields.

**35267 Hydrogen migration mechanism for ligand substitution reactions in metal carbonyl hydrides.** Pearson, R.G.; Walker, H.W.; Mauermann, H.; Ford, P.C. (Univ. of California, Santa Barbara). Contract AS03-76SF0034. *Inorganic Chemistry ;* **20**: No. 8, 2741-2742(Aug 1981).

It has been known for some time that certain transition metal carbonyl hydrides are unusually labile in ligand substitution processes. A mechanism explaining this unusual lability was offered involving a ligand migration of hydrogen to a carbonyl group, attack at the vacated coordination site y the entering ligand, loss of a CO ligand, and back-migration of H to the metal. The following recent experiments offer strong support for this hydride migration. (A) In acetone at -70°C $H_2Fe(CO)_4$ reacts within 3 min with $PPh_3$ to give $H_2Fe(CO)PPh_3$ and with $P(OMe)_3$ to give $H_2Fe(CO)_3P(OMe)_3$ and $H_2Fe(CO)_2[P(OMe)_3]_2$. The phosphine and phosphites are cis to both hydrogens, and the hydrogens are probably cis to each other. The same results are found in methanol at room temperature. These substitutions are at least 30 times as fast as the thermal decomposition of $H_2Fe(CO)_4$ in methanol. $H_2Fe(CO)_3PPh_3$ decomposes at a rate similar to that of $H_2Fe(CO)_4$ and yields trans-$Fe(CO)_3(PPh_3)_2$ in the presence of triphenylphosphine. (B) $H_2Ru(CO)_4$ in acetone at -70°C also gives $H_2Ru(CO)_3P(OMe)_3$ in a few minutes with the phosphite cis to hydrogen. Upon warming $H_2Ru(CO)_2[P(OMe)_3]_2$ is formed. (C) In methanol at 25°C the ion $HRu(CO)_4^-$, as the $PPN^+$ salt, is converted immediately into $HRu_3(CO)_{11}^-$. Adding excess sodium methoxide (about 0.4 M) slows the reaction time down to about 15 min, but the same product is formed.

**35268 $Pd/SiO_2$. I. In situ x-ray diffraction studies during treatment and hydrogenolysis.** Nandi, R.K.; Pitchai, R.; Wong, S.S.; Cohen, J.B.; Burwell, R.L. Jr.; Butt, J.B. (Northwestern Univ., Evanston, IL). Contract AC02-77ER04254. *Journal of Catalysis ;* **70**: No. 2, 298-307(Aug 1981).

Simple techniques for studies of x-ray diffraction from $Pd/SiO_2$ catalysts during catalytic reactions are reported here. The catalytic activity of $Pd/SiO_2$ of low percentage metal exposed for methylcyclopropane hydrogenolysis at 0°C is less for catalyst cooled from 450°C in $H_2$ than for that cooled in He. This effect appears to result from differing amounts of hydride formation. Ease of formation of hydride decreases with decreasing Pd particle size. Exposing the catalysts with D/sub h/ = 13.8 and 29.3% to hydrogen at ~ 25°C results in nearly complete conversion of particles of Pd to hydride. Purging with helium (even at 0°C) reconverts the hydride to palladium, but this reconversion exhibits an induction period; hydride formation is more rapid. Passing hydrogen plus methylcyclopropane results in the conversion into hydride of a substantial fraction of catalyst particles originally present as palladium. The palladium hydride particles of catalyst produced by cooling from 450°C in $H_2$ remain as $PdH_{0.7}$ during the hydrogenolysis reaction. The lattice parameter of palladium particles is indistinguishable from that of bulk palladium, at least for particle diameters ≧ 45 A.

**35269 Kinetics and mechanism of carbon monoxide hydrogenation over alumina-supported ruthenium.** Kellner, C.S.; Bell, A.T. (Lawrence Berkeley Lab., CA). Contract W-7405-ENG-48. *Journal of Catalysis ;* **70**: No. 2, 418-432(Aug 1981).

A study was conducted of hydrocarbon synthesis from CO and $H_2$ over an alumina-supported Ru catalyst. Rate data for the formation of methane and $C_2$ through $C_{10}$ olefins and paraffins were fitted by power law rate expressions. The kinetics observed experimentally can be interpreted in terms of a comprehensive mechanism for CO hydrogenation, in which CH/sub x/ (x = 0 to 3) species play a primary role. Expressions for the kinetics of methane synthesis, the kinetics and distribution of C/sub 2+/ olefins and paraffins, and the probability of hydrocarbon chain growth derived from this mechanism are found to be in good agreement with the experimental results. The observed deviations from theory can be ascribed to secondary processes such as olefin hydrogenation and paraffin hydrogenolysis.

**35270 Metal-hydrogen bridge bonding of hydrocarbons on metal surfaces.** Gavin, R.M. Jr. (Haverford College, PA); Reutt, J.; Muetterties, E.L. *Proceedings of the National Academy of Sciences of the United States of America ;* **78**: No. 7, 3981-3985(Jul 1981).

Molecular orbital studies implicate multicenter metal-hydrogen-carbon interactions as contributors to the bonding of chemisorbed hydrocarbons on clean metal surfaces. The most stable geometries appear to be those that achieve the maximum multicenter bonding to the coordinately unsaturated metal atoms in the vicinity of the anchoring metal-carbon interaction. Energy differences between possible surface sites are of the same magnitude as stabilization energies for three-center bonding of hydrogen atoms to the metal surface. Accordingly, secondary interactions of hydrogen with neighboring metal atoms may be significant determining factors in surface structures. The model predictions are compared with known structures and are used to propose a mechanism for hydrocarbon reactions on metal surfaces. These metal-hydrogen-carbon interactions are presumed to be intermediate points or states in C-H bond-breaking processes.

**35271 Kinetics and mechanism of the oxidation of (α-hydroxyalkyl)chromium complexes by copper(II) and iron(III) ions.** Bakac, A.; Espenson, J.H. (Ames Lab., IA). Contract W-7405-ENG-82. *Journal of the American Chemical Society ;* **103**: No. 10, 2721-2728(20 May 1981).

Copper(II) and iron(III) ions react with (α-hydroxyalkyl)chromium(2+) complexes (alkyl = methyl, ethyl, 2-propyl) in water or in aqueous alcohol solutions leading to the cleavage of the chromium-carbon bond. The immediate products are $Cr^{2+}$, the reduced metal ion ($Cu^+$ or $Fe^{2+}$), and the corresponding aldehyde or ketone. The reactions obey the rate law $-d[CrROH^{2+}]/dt = (k + k'[H]^{-1}[CrROH^{2+}][M]$, where M = $Cu^{2+}$ or $Fe^{3+}$. The dominant k' term has the following values in 1 M aqueous parent alcohol (methanol, ethanol, and 2-propanol, respectively): $CrCH_2OH^{2+}$, k'/sub Cu/ = 0.251 $s^{-1}$,k'/sub Fe/ = 0.496 $s^{-1}$; $CrCH(CH_3)OH^{2+}$, 1.46, 0.481; $CrC(CH_3)_2OH^{2+}$, 0.574, 1.90. The reactivity toward $Cu^{2+}$ and $Fe^{3+}$ is significantly diminished upon substitution of the OH hydrogen by an alkyl group. Copper(II) does not react with (α-alkoxyalkyl)chromium(2+) complexes at all, while iron(III) shows some reactivity with k'/sub Fe/ = 0.0127 $s^{-1}$ ($CrCH_2OCH_3^{2+}$) and 0.0400 $s^{-1}$ ($CrCH(CH_3)OC_2H_5^{2+}$), both in 1 M methanol. A mechanism proposed for the oxidation of (α-hydroxyalkyl)chromium(2+) complexes by copper(II) and iron(III) consists of the oxidant attack at the alcoholic OH group followed by a slow electron-transfer step.

**35272 Concurrent electrophilic and oxidative pathways for reactions of α-hydroxyalkyl and α-alkoxyalkyl complexes of chromium(III) with mercury(II) ions.** Espenson, J.H.; Bakac, A. (Ames Lab., IA). Contract W-7405-ENG-82. *Journal of the American Chemical Society ;* **103**: No. 10, 2728-2733(20 May 1981).

The reactions of $Hg^{2+}$ with a number of α-hydroxyalkyl and α-alkoxyalkyl complexes of chromium(III) were studied. The lowest members of both series, $CrCH_2OH^{2+}$ and $CrCH_2OCH_3^{2+}$, react with $Hg^{2+}$ in an acid-independent electrophilic substitution reaction with the reaction constant rho = 10. The organomercurials formed are unstable and decompose rapidly to yield $Hg^0$. All the other organochromium complexes studied react with $Hg^{2+}$ in acid-dependent electron-transfer reactions. (α-Hydroxyisopropyl(chromium ion, $CrC(CH_3)_2OH^{2+}$, undergoes a one-electron transfer reaction, producing $Cr^{2+}$ and $Hg^+$ with k $(M^{-1}s^1)$ = 166 + 467/[$H^+$], while (α-ethoxyethyl)chromium ion, $CrCH(CH_3)OC_2H_5^{2+}$, reacts in a two-electron redox process, yielding $Cr^{3+}$ and $Hg^0$, k $(M^{-1}s^{-1})$ = 0.535/[$H^+$]. (α-

Hydroxyethyl)chromium ion, $CrCH(CH)_3OH^{2+}$ reacts by both routes, $k(M^{-1} s^{-1}) = 4.11/[H^+]$, with ~ 15% participation from the one-electron path and ~ 85% from the two-electron path. The effect of $Cr^{2+}$ and $Co(NH_3)_5F^{2+}$ (a specific scavenger for $Cr^{2+}$) on the kinetics and stoichiometry of the reactions is discussed.

**35273 Ion product of water substance, 0—1000 °C, 1—10,000 bars New International Formulation and its background.** Marshall, W.L.; Franck, E.U. (Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Journal of Physical and Chemical Reference Data ;* **10**: No. 2, 295-304(Apr 1981).

This paper is the background for a new international formulation for the ion product of water substance (May 1980) issued by the International Association for the Properties of Steam. The ion product of water (K/sub w/) is represented by an equation, based on density and two quadratic functions of reciprocal absolute temperature, for use from 0 to 1000 °C and 1 to 10,000 bars pressure. The equation is believed to describe within +- 0.01 units of log K/sub w/( (where K/sub w/( equals K/sub w//(mol $kg^{-1})^2$) many of the measurements at saturated vapor pressure up to 200 °C, and to within +- 0.02 units up to the critical temperature (374 °C). It also describes within the experimental uncertainty the several sets of measurements at high pressures and should provide values within +- 0.05 and 0.30 units at low and high temperatures, respectively.

**35274 Treatment of pressure effects on ionization constants in aqueous solution.** Marshall, W.L.; Mesmer, R.E. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Journal of Solution Chemistry ;* **10**: No. 2, 121-127(Feb 1981).

Effects of pressure on ionization constants are described more simply by the use of solvent density rather than pressure. The recent ionization constants of metal sulfates in aqueous solution of Fisher and Fox (Chemistry Division, Oak Ridge National Laboratory) are used to demonstrate greater predictability with density.

## 4003 Organic Chemistry

*REFER ALSO TO CITATION(S) 34233, 34237, 34481, 35163, 35246, 35250, 35256, 35257, 35258, 35259, 35260, 35264, 35265, 35268, 35271, 35272, 35573*

**35275 (DOE/ER/04903—3) Palladium-catalyzed coupling reactions: mechanism of reductive elimination. Progress report, October 1, 1980-June 30, 1981.** Stille, J.K. (Colorado State Univ., Fort Collins (USA)). Jun 1981. Contract AS02-78ER04903. 28p. NTIS, PC A03/MF A01. Order Number DE81030169.

The mechanisms of the reductive elimination of alkyl partners from palladium, particularly under reaction conditions characteristic of the palladium-catalyzed coupling of organic halides and organometals, can take place either from Pd(II) or Pd(IV). The coupling of alkyl groups from a dialkylpalladium(II) complex requires that the organic partners be cis to one another. The reaction is a first-order intramolecular process that sometimes requires prior dissociation of a ligand, leading to a Y-or T-shaped intermediate. Coupling also can take place by the prior oxidative addition of organohalide to the dialkylpalladium(II) complex to yield a palladium(IV) species from which reductive elimination takes place rapidly. The reductive elimination step takes place with retention of geometry at an $sp^2$ carbon, and retention of configuration at an $sp^3$ carbon. Which catalytic reversible cycle, Pd(O) → Pd(II) or Pd(II) → Pd(IV) operates depends on the organic groups, the ligands and the reaction solvent.

**35276 (ORNL/TM—7474) Destruction of oxalate by reaction with hydrogen peroxide.** Mailen, J.C.; Tallent, O.K.; Arwood, P.C. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 30p. NTIS, PC A03/MF A01. Order Number DE81030624.

The destruction of oxalate by oxidation to carbon dioxide using hydrogen peroxide was studied as an alternative method for the disposal of oxalate in connection with the possible use of an aqueous hydrazine oxalate solution as a scrubbing agent for solvent cleanup in processes for the recovery of uranium, plutonium, and thorium by solvent extraction. The rate of oxidation of oxalate by hydrogen peroxide in acid solution at the reflux temperature was adequate for process application; reaction half-times at 100°C were less than one hour when the hydrogen peroxide concentration was greater than 0.5 M. The reaction was first order with respect to both the oxalate and hydrogen peroxide concentrations and had an activation energy of 58.7 kJ/g-mol. The rate increased with the hydrogen ion concentration as $[H^+]^{0.3}$ but was not significantly affected by the presence of 100 ppM of uranium or copper in solution. In the near-neutral hydrazine oxalate solutions, the reaction of either component with hydrogen peroxide was too slow for process application.

**35277 (RFP—3271) Incineration of polychlorinated biphenyl using a fludized-bed incinerator.** Johnson, A.J.; Meyer, F.G.; Hunter, D.I.; Lombardi, E.F. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 18 Sep 1981. Contract AC04-76DP03533. 25p. NTIS, PC A02/MF A01.

A trial burn of polychlorinated biphenyl (PCB) transformer fluid in a fluidized bed incinerator has been completed at Rocky Flats Plant (RFP). Extensive sampling procedures were used to assess the efficiency of the burn; analysis by Rocky Flats Plant laboratories of the samples collected gave a 99.99992 percent PCB destruction efficiency. This compares well with the independent EPA analysis indicating that 99.9999 percent of the PCB was destroyed. The fluidized bed incinerator utilizes a chromic oxide catalyst to achieve destruction at the relative low operating temperature of 600°C and a primary bed of $Na_2CO_3$ to neutralize combustion-generated HCl into NaCl. A low operating temperature permits an all-metal system to be used and the dry off-gas system negates the need of a water or caustic-filled scrubber.

**35278 Rate constants for the reaction of ground state atomic oxygen with methanol.** Keil, D.G.; Tanzawa, T.; Skolnik, E.G.; Klemm, R.B.; Michael, J.V. (Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics ;* **75**: No. 6, 2693-2704(15 Sep 1981).

The reaction of $O(^3P)$ with methanol has been studied using the complementary discharge flow and flash photolysis techniques. In both cases, resonance fluorescence detection of atomic oxygen was employed. The discharge flow (DF) apparatus was used in a temperature range of 298—998 K while the flash photolysis (FP) apparatus was used in the overlapping range of 329—527 K. The apparent bimolecular rate constants for the O-atom/methanol reaction obtained from DF experiments at low temperatures (T< or =450 K) were independent of both the initial O-atom concentration and the mode of O-atom production. In addition, large excesses of $O_2$ were added to the flow to intercept the primary reaction product ($CH_3OH$), but had no apparent effect on the measured rate constant. Results from the two methods were in good agreement within this limited temperature range (~300—500 K). At temperatures above ~450 K, the apparent rate constants obtained from DF experiments were increasingly sensitive to the $O_2$ concentration, with the rate constants being smaller when determined in the presence of large $[O_2]$. Since the initial O-atom concentrations were on the order of $10^{11}$ or less, a simple stoichiometry effect can be ruled out. However, the results of the present kinetic experiments indicated that heterogeneous pyrolysis of $CH_3OH$ may have occurred in the flow system. This observation is consistent with studies of the adsorption of methanol on silica surfaces. This problem was apparently overcome by adding small amounts of $O_2$ and the rate constants obtained in this way were seen to agree well with values extrapolated from the lower temperature DF and FP experiments. The rate data from DF and FP experiments were thus combined to obtain the following Arrhenius expression (298—998 K): $k_1(T) = (2.70 +- 0.50) \times 10^{-11} \exp(-5030 +- 160/RT$ $cm^3$ $molecule^{-1}$ $s^{-1}$.

**35279 Finding transition states.** Cerjan, C.J.; Miller, W.H. (Department of Chemistry and Materials and Molecular Research Division of the Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics ;* **75**: No. 6, 2800-2806(15 Sep 1981).

An algorithm for locating transition states on a potential energy surface is described. The most important feature of the algo-

rithm, which makes explicit use of the second derivative matrix of the potential surface, is that it is able to "walk uphill" from the minimum on a potential surface to the transition state essentially automatically. The method is illustrated by application to a two dimensional model problem, to the vinylidene—acetylene rearrangement ($H_2C$ = C:bold-arrow-left-rightHCequivalentCH), and to the dissociation and rearrangement of formaldehyde ($H_2C$Obold-arrow-left-right$H_2$+CO, HCOH). The algorithm is also seen to provide an improved way of following a reaction path from a transition state down to reactants or products.

**35280 Polarized resonance Raman spectroscopy of the photointermediate of oxyhemoglobin on the picosecond time scale.** Nagumo, M.; Nicol, M.; El-Sayed, M.A. (Univ. of California, Los Angeles). Contract AS03-76SF0034. *Journal of Physical Chemistry ;* **85**: No. 17, 2435-2438(20 Aug 1981).

Polarized resonance Raman spectra of the photoproduct of $HbO_2$ have been obtained with 50-ps, 550-nm pulses, from a nJ/pulse cavity-dumped laser and sample flow techniques. The frequencies and polarizations of three bands known to be correlated with porphyrin core size correspond, within experimental errors, to those previously reported for the photoproduct of HbCO on the same time scale. These results suggest that the iron is converted to the high-spin state and that it remains in or near the heme plane on this time scale. Only slight evidence of photolysis is observed on the nanosecond scale. This is attributed to the rapid geminate recombination of the photodissociated $O_2$ and Hb.

**35281 Effect of temperature on the properties of mixed normal micelles in sodium octanoate-1-pentanol-water systems studied by positron annihilation technique.** Boussaha, A.; Ache, H.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg). *Journal of Physical Chemistry ;* **85**: No. 17, 2444-2447(20 Aug 1981).

Positron annihilation technique was applied to the study of structural properties of mixed normal micelles in sodium octanoate-1-pentanol-water systems. Measurements of positron annihilation parameters over a wide range of temperature and surfactant concentrations demonstrate the extreme sensitivity of the technique toward the structural changes associated with the second and third critical concentrations. While the third critical concentration appears to be temperature independent, the second critical concentration is shifted to slightly lower values at higher temperatures (from ~ 1.4 m to ~ 1.0 m on going from 21 to 51°C). The plot of the Arrhenius activation energies of positronium formation as a function of surfactant molality indicates some continuous changes in the properties of the micelles below and above the third concentration.

**35282 Generation of transition-metal polysulfide ions in the gas phase by sequential reactions of metal ions with ethylene sulfide.** Carlin, T.J.; Wise, M.B.; Freiser, B.S. (Purdue Univ., West Lafayette, IN). Contract AC02-80ER10689. *Inorganic Chemistry ;* **20**: No. 8, 2743-2745(Aug 1981).

Using the technique of laser ionization ion cyclotron resonance (ICR), studies of metal ion reactions with sulfur compounds were conducted. An unexpected behavior was observed with ethylene sulfide upon reaction with $Fe^+$, $Co^+$, $V^+$, and $Ti^+$. Successive attachments of sulfur was the dominant process in each case. As a specific example, $V^+$ was found to attach at least eight sulfur atoms. It appeared that, after two sulfur attachments, $H_2$ loss began to compete with $C_2H_2$ loss in subsequent dissociative attachments. This resulted in what was postulated to be the formation of stable dithiolenes.

**35283 New procedure for the chlorination of pyrimidine and purine nucleosides.** Ryu, E.K.; MacCoss, M. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *Journal of Organic Chemistry ;* **46**: No. 13, 2819-2823(19 Jun 1981).

The reaction between 1-B-D-arabinofuranosylcytosine hydrochloride (araC.HCl) and a slight molar excess of m-chloroperbenzoic acid (MCPBA) in an aprotic solvent such as dimethylformamide (DMF), dimethylacetamide (DMA), or hexamethylphosphorus triaide was examined. Chromatographic evaluation of the reaction mixture showed two major components, unreacted starting material, and a reaction product having a slightly greater R/sub f/ value. The reaction between MCPBA and other pyrimidine and purine derivatives in dipolar aprotic solvents containing HCl was investigated. In the pyrimidine series both uracil and cytosine derivatives gave the corresponding 5-chloro derivatives in high yield after a facile workup. Application of the same reaction conditions to the purine derivatives adenosine and guanosine gave the 8-chloro nucleosides in good yield, thus producing 8-chlorogyanosine. The product 9-B-D-arabinofuranosyl-8-chloroadenine was obtained when the reaction was applied to the potent antiviral agent 9-B-D-arabinofuraosyladenine. The new chlorination method gives good to excellent yields, short reaction times, mild reaction conditions and ready availability of starting materials. 1 table. (DP)

**35284 Transition-metal nitro-nitrosyl redox couple: catalytic oxidation of olefins to ketones.** Andrews, M.A.; Kelly, K.P. (Brookhaven National Lab., Upton, NY). *Journal of the American Chemical Society ;* **103**: No. 10, 2894-2896(20 May 1981).

A new nitroso-nitrosyl redox couple based on the readily prepared complex bis(acetonitrile)chloronitropalladium(II) is reported which catalytically air oxidizes olefines to ketones. Results of $^{18}O$ labelling mechanistic studies are included, and spectroscopic evidence for an intermediate involved in oxygen-atom transfer by a nitro group is presented. The effects of olefin substituents were also investigated. (BLM)

**35285 Interaction of mercaptans with cyclohexene.** Gadzhiyev, M.K.; Nebiyeridze, N.M.; Areshidze, Kh.I. *Petroleum Chemistry USSR (English Translation) ;* **20**: No. 1, 22-26(1980).

Translated from Neftekhimiya; 20: No. 1, 127-130(1980).

A study was made of thermal interaction of ethanethiol, n-propane-1-thiol, isopropanol, n-butane-1-thiol and n-pentanethiol with cyclohexene in a wide range of temperature, space velocity and molar ratios of reagents in the continuous system. The corresponding alkylcyclohexylsulfides are the main reaction products.

**35286 Application of linear equations including several parameters to characterize the selectivity of solvents in extraction.** Makitra, R.G.; Pirig, Ya.N. (Inst. of Geology and Geochemistry of Mineral Fuels, Lvov, USSR). *Petroleum Chemistry USSR (English Translation) ;* **20**: No. 1, 27-38(1980).

Translated from Neftekhimiya; 20: No. 1, 145-154(1980).

Relative coefficients of activity of a number of hydrocarbons in solvents show satisfactory correlation with properties of solvents using linear five-parameter equations to allow for the polarity, polarization properties, solubility, basicity and electrophilic properties of solvents. Since various parameters are of major significance for protonic and aprotic solvents, they have to be examined separately. A plan was proposed concerning the importance in extraction of electrophilic properties of solvents, 2 figures, 6 tables.

**35287 uv spectroscopic study of the adsorption of thiophen, thiophan and thiophenol on alumina and alumino-silica gel.** Akhmetova, G.G.; Zubareva, N.A.; Kiselev, A.V.; Lygin, V.I. (State Univ., Moscow, USSR). *Petroleum Chemistry USSR (English Translation) ;* **20**: No. 1, 67-71(1980).

Translated from Neftekhimiya; 20: No. 2, 285-288(1980).

Thiophan and thiophen are adsorbed on alumina reversibly in the entire temperature range studied. The appearance of long-wave absorption bands in spectra of thiophan and thiophen adsorbed by alumino-silica gel points to the formation of surface-charged intermediate compounds. In the case of thiophenol both on alumina andumino silica gel disproportionation takes place in the temperature range between room temperature and 200°.

**35288 Miscibility in systems containing aqueous solutions of various alkylbenzenesulfonates, toluene and, n-butanol.** Ho, P.C.; Kraus, K.A. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Journal of Colloid and Interface Science ;* **70**: No. 3, 537-543(Jul 1979).

Miscibility relationships in four-component systems containing sodium alkylbenzenesulfonates, toluene, n-butanol, and water were studied at 25°C in the hope of clarifying the complex systems used in the micellar flood enhanced oil recovery process. Phase boundary curves for the pseudo three-component systems (constant

sulfonate/water ratios, 2.5 moles sulfonate per kg water) were determined. The sulfonates included those of benzene, toluene, xylene, ethylbenzene, isopropylbenzene, mesitylene, cymene, methyl-t-butylbenzene, and diisopropylbenzene, in all of which the alkyl substituents are smaller than in the usual surfactants. The phase boundary curves have similar and fairly symmetrical shapes. The amount of n-butanol (cosolvent) required to produce miscibility decreases with increasing number of alkyl carbons on the benzene ring of the sulfonates and seems relatively independent of the isomeric structure. The sodium salt of diisopropylbenzenesulfonate gives the lowest phase boundary curve (least n-butanol required for miscibility) among the nine sulfonates studied.

35289 **Kinetics studies of the cleavage and rearrangement reactions of ($\beta$-hydroxyalkyl)cobaloximes in acid solution.** Espenson, J.H. (Ames Lab., IA); Wang, D.M. *Inorganic Chemistry ;* **18**: No. 10, 2853-2859(1979).

Kinetics studies have been carried out on the title reactions. $\beta$-Hydroxyethyl derivatives evolve ethylene, whereas $\beta$-hydroxy-n-propyl and $\beta$-hydroxyisopropyl derivatives undergo reversible isomerization prior to olefin release. The kinetic data are analyzed in terms of a mechanism involving an intermediate in which the olefin is $\pi$ bonded to the cobalt complex. Based on this analysis it is possible to evaluate: (1) rate constants for the conversion of each of the parent compounds to the $\pi$ intermediate; and (2) values for return of the $\pi$ complex to the parent alkyl(s) compared to those for product formation. The cleavage reactions of the $BF_2$-substituted macrocycle are much slower than for the bis(dimethylglyoximato) compounds, indicating the sensitivity of the reaction rate to electron-attracting substituents. Chloride ion causes modest rate accelerations, presumably because of its nucleophilicity when present in the complex trans to the cobalt-carbon bond.

35290 **Graph-based fragment searches in polycyclic structures.** Randic, M.; Wilkins, C.L. (Univ. of Nebraska, Lincoln). *Journal of Chemical Information and Computer Sciences ;* **19**: No. 23, 23-31(1979).

A procedure for substructure search in polycyclic systems based upon the concept of atom codes and their comparison is outlined. The atom codes used represent the number of paths of different length originated at each atom. This scheme represents an extension to polycyclic structures of a recently described algorithm for fragment searches in acyclic structures. The basic idea of using the number of neighbors and number of paths for characterization of an atomic environment is not unfamiliar. However, it appears that the accompanying formalism has not been developed previously. The path concept has found much application in various problems relating graphs and structures, but previously the primary emphasis has been the search for shortest paths. Here we show it is useful to list all paths (to any desired depth) for all atoms in a structure and then to use such a list for substructure searches. Essentially, comparison of the lists of paths for two graphs permits establishing compatibilities among the vertices and results in assignment of multiple labels to the graph under investigation, where the labels are those of the fragment. Subsequent atom-by-atom matching is straightforward and efficient, since the use of multiple labeling prevents a large number of otherwise unproductive searches from even being considered. By successive registration of a fragment, vertices whose labels have been exhausted are deleted and the process repeated on a smaller graph with fewer multiple labels-which makes possible rapid convergence in the search. This search procedure is illustrated with an example. 16 figures, 2 tables.

35291 **(UCRL-Trans—11718) Study of the chemiluminescent catalytic reaction in a luminol-copper-hydrogen peroxide system.** Babko, A.K.; Lukovskaya, N.M. Translated from *Ukrainskii Khimicheskii Zhurnal (Russian Edition) ;* **27**: 519-524(1961). 15p. NTIS, PC A02/MF A01. Order Number DE81030343.

A quantitative photographic method has been worked out for investigating and making analytical use of the chemiluminescent catalytic reaction among luminol, copper, and hydrogen peroxide based on total luminescence. With chemiluminescence taken as a property of the system, the method of physiochemical analysis was used to establish the following relationships between reactants: Cu:L = 1:1, and CuL:$H_2O_2$ $\approx$ 1:1. The formation of the intermediate complex CuL plays a principal part in the chemiluminescence of the reaction in question. It has been found that the optimal condition for detection of copper is pH > 11 in the absence of outside complexing agents for copper. Excess ammonia and other complexing agents for copper lower the sensitivity of the reaction.

## 4005 Photochemistry

*REFER ALSO TO CITATION(S) 35280, 35298*

35292 **Aspects of artificial photosynthesis. Photosensitized electron transfer across bilayers, charge separation, and hydrogen production in anionic surfactant vesicles.** Tunuli, M.S.; Fendler, J.H. (Texas A and M Univ., College Station). *Journal of the American Chemical Society ;* **103**: No. 10, 2507-2513(20 May 1981).

Photosensitized electron transfer from tris(2,2'-bipyridine)ruthenium cation, $Ru(bpy)_3^{2+}$, to methylviologen, $MV^{2+}$, has been investigated in the presence of negatively charged dihexadecyl phosphate, DHP, surfactant vesicles by steady state photolysis, fluorescence quenching, and nanosecond laser flash photolysis. Four different substrate-surfactant vesicle organizations have been used. In system I, $Ru(bpy)_3^{2+}$ was attached to the outer and $MV^{2+}$ was placed onto the inner surfaces of DHP vesicles. In system II, $MV^{2+}$ was attached to the outer and $Ru(bpy)_3^{2+}$ to the inner surfaces of DHP vesicles. In system III, both $Ru(bpy)_3^{2+}$ and $MV^{2+}$ were localized on the outer surfaces of DHP vesicles. In system IV, both $Ru(bpy)_3^{2+}$ and $MV^{2+}$ were localized on the inner surfaces of DHP vesicles. Extremely efficient electron transfers have been observed on the surfaces of surfactant vesicles in systems III and IV. Electron transfer from excited $Ru(bpy)_3^{2+}$ to $MV^{2+}$ across the bilayers of vesicles in the presence of externally added EDTA in system I resulted in the formation of reduced methylviologen, $MV^{+}$., up to 75% conversion with a quantum efficiency of 2.40 x $10^{-2}$. If additionally $\sim 10^{-5}$ M $PtO_2$ was entrapped in the interiors of DHP vesicles in system I, $MV^{+}$. promptly reformed with concomitant hydrogen evolution. Photolysis of this system leads to the net consumption of only EDTA at very low stoichiometric $Ru(bpy)_3^{2+}$, $MV^{2+}$, and $PtO_2$ concentrations. Dynamics of these processes have been determined and their relevance to photochemical solar energy conversions is discussed.

35293 **(DOE/ER/10396—T1) Studies of free radicals by ultraviolet excimer laser photolysis. Progress report, 1 April 1981-1 October 1981.** Leone, S.R. (Colorado Univ., Boulder (USA)). 1981. Contract AS02-79ER10396. 29p. NTIS, PC A03/MF A01. Order Number DE82000688.

Recent progress is described on the study of the reactions, energy transfer, and dynamics of free radicals produced by ultraviolet laser photolysis. Free radical chain reactions are analyzed by fully time-resolved techniques involving infrared emission spectroscopy. Some of the most recent results include a mesurement of the low resolution infrared spectrum of the $CH_3(\nu_2)$ out-of-plane bending vibrational progression. Complex chain reaction chemistry has been studied via the laser-initiated chain reaction technique to provide a general analysis of the method to obtain rate constants and to probe the time evolution of energy disposal and product formation. Methods have been developed to probe very slow chain reactions and to measure absolute rate constants for methyl radical reactions. A brief review of results from previous years is also given.

35294 **Infrared photolysis of Ar.$BCl_3$.** Casassa, M.P.; Bomse, D.S.; Janda, K.C. (California Inst. of Tech., Pasadena). Contract AT03-76ER10487. *Journal of Physical Chemistry ;* **85**: No. 18, 2623-2625(3 Sep 1981).

The infrared photodissociation spectrum of Ar.$BCl_3$ is reported. Spectra obtained by using a c-w $CO_2$ laser are dominated by homogeneous broadening due to vibrational predissociation of excited van der Waals molecules. The predissociation lifetime of Ar.$BCl_3$ containing one quantum of vibrational excitation in the $BCl_3\nu_3$ mode is between 1 and 3 ps. Results presented are discussed in terms of the efficiency and isotopic selectivity of the photodissociation process.

35295 **Magnetic resonance spectroscopy of the primary state, P/sup F/, of bacterial photosynthesis.** Bowman, M.K. (Argonne National Lab., IL); Budil, D.E.; Closs, G.L.; Kostka, A.G.; Wraight, C.A.; Norris, J.R. *Proceedings of the National Academy of Sciences of the United States of America ;* **78**: No. 6, 3305-3307(Jun 1981).

We have obtained the magnetic resonance spectrum of the radical pair state P/sup F/ by using reaction yield detected magnetic resonance spectroscopy. The magetic resonance spectrum is quite sensitive to the local environment of P/sup F/. The data place limits on the lifetime of triplet P/sup F/ and the distance of charge separation. 2 figures.

35296 **Previously unreported intense absorption band and the pK/sub a/ of protonated triplet methylene blue.** Ohno, T.; Osif, T.L.; Lichtin, N.N. (Boston Univ., MA). Contract EY-76-S-02-2889. *Photochemistry and Photobiology ;* **30**: 541-546(1979).

Excitation by a Q-switched giant ruby laser (1.2 J output at 694 nm, ~ 50 ns flash) of 2 to 10 $\mu$M solutions of methylene blue in water, 30% ethanol in water or 50 v/v% water-$CH_3CN$ at pH values in the range 2.0 to 9.3 converted the dye essentially completely to its $T_1$ state. The absorption spectrum of $T_1$ dye was measured in different media at pH 2.0 and 8.2 by kinetic spectrophotometry. Previously reported T-T absorption in the violet in acidic and alkaline solutions and in the near infrared in alkaline solution was confirmed. Values found for these absorptions in the present work with 30% ethanol in water as solvent are $\lambda$/sub max/ ~ 370 nm, $\epsilon$/sub max/ ~ 13,200 $M^{-1}cm^{-1}$ at pH 2 and $\lambda$/sub max/ ~ 420 nm, $\epsilon$/sub max/ ~ 9000 $M^{-1}cm^{-1}$, $\lambda$/sub max/ ~ 840 nm, $\epsilon$/sub max/ ~ 20,000 $M^{-1}cm^{-1}$ at pH 8.2. Long-wavelength T-T absorption in acidic solution is reported here for the first time: $\lambda$/sub max/ ~ 680 nm, $\epsilon$/sub max/ ~ 19,000 $M^{-1}cm^{-1}$ in 30% ethanol in water at pH 2. Observation of a pH-independent isobestic point ~ 720 nm confirms that the long-wavelength absorptions are due to different protonated states of the same species, $MB^+$ ($T_1$) and $MBH^{2+}$ ($T_1$). The pK/sub a/ of $MBH^{2+}$ ($T_1$) in water was determined from the dependence on pH of absorption at 700 and 825 nm to be $7.4_4$ +- 0.1 and from the kinetics of decay of triplet absorption to be 7.2. The specific rate of protonation of $MB^+$ ($T_1$) by $H_2PO_4^-$ in water at pH 4.4 was found to be 4.5 +- 0.4 x $10^8$ $M^{-1}$ $s^{-1}$.

35297 **Non-photochemical hole burning and its relation to the fluorescence and structure of organic glasses.** Hayes, J.M.; Small, G.J. (Ames Lab., IA). Contract W-7405-ENG-82. *Journal of Luminescence ;* No. 18/19, 219-223(1979).

To explain the appearance of laser induced sharp persistent holes burnt into inhomogeneously broadened impurity spectra in organic glasses, a two level systems structural model for the glass is proposed. Non-photochemical hole burning data pertaining to the density of states and relaxation processes of the two level systems are presented.

## 4006 Radiation Chemistry

35298 **(DOE/ER/00038—2262) Radiation Laboratory, University of Notre Dame. Quarterly report, April 1, 1981-June 30, 1981.** (Notre Dame Univ., IN (USA). Radiation Lab.). 14 Jul 1981. Contract AC02-76ER00038. 47p. NTIS, PC A03/MF A01. Order Number DE81030942.

Sixty-six abstracts are presented of individual research projects in the fields of radiation chemistry and photochemisty. (DLC)

35299 **Electron spin resonance study of silver atom solvation in methyl cyanide at 4.2°K.** Li, A.S.W.; Kevan, L. (Univ. of Houston, TX). *Journal of Physical Chemistry ;* **85**: No. 17, 2557-2562(20 Aug 1981).

Silver atoms formed by x irradiation of frozen, methyl cyanide solutions of silver perchlorate are studied at 4.2°K by electron spin resonance. It is observed that there is no dramatic site change upon 77°K annealing but there is some increase in $Ag^0$ intensity and sharpening of the hyperfine structure upon 77°K annealing. These results imply that there is some rearrangement of the atom toward equilibrium solvation upon thermal annealing. If the irradiated sample is subjected to visible light at 4.2°K, a new $Ag^0$ site, site CNI, is observed which is similar to $Ag^0$ site 2020 in the EtOH-$H_2O$ solvent system. The site CNI disappears upon 77°K annealing and can be recovered upon visible light illumination.

35300 **Reactions of iron porphyrins with methyl radicals.** Brault, D.; Neta, P. (Univ. of Notre Dame, IN). *Journal of the American Chemical Society ;* **103**: No. 10, 2705-2710(20 May 1981).

The reactions of methyl radicals with ferric, ferrous, and iron-free-deuteroporphyrin have been investigated in neutral and alkaline water-2-propanol mixtures. Steady-state radiolysis of methyl chloride saturated solutions of ferric deuteroporphyrin, or chemical reduction of ferric deuteroporphyrin solutions containing methyl iodide, led to a new species which is spectrophotometrically characterized. The yield ($G \simeq 3$) and the redox titration (2 reducing equivalents) strongly suggest the structure DPFe/sup III/$CH_3$. This product is found to be stable under anaerobic conditions but is oxidized to the initial ferric form in the presence of air. Pulse radiolysis experiments show that methyl radicals react with both ferric and ferrous deuteroporphyrin with reaction rate constants of 2.3 x $10^9$ and 3.9 x $10^9$ $M^{-1}$ $s^{-1}$, respectively. The reaction with iron-free deuteroporphyrin is much slower, demonstrating that methyl radicals react with iron porphyrin at the iron center. The transient species resulting from the scavenging of a methyl radical by ferric porphyrin DPFe/sup IV/$CH_3$ undergoes a further slow reaction leading to ferrous deuteroporphyrin (t/sub 1/2/ $\simeq$ 200 $\mu$s). Electron (or methyl) transfer between DPFe/sup IV/CHT# and ferrous deuteroporphyrin leading to DPFe/sup III/$CH_3$ and ferric deuteroporphyrin is shown to occur with a second-order rate constant k = 4 x $10^8$ $M^{-1}$ $s^{-1}$. The reactions of $\alpha$-hydroxyisopropyl radicals with ferric, ferrous, and iron-free deuteroporphyrin and with methyl iodide were also studied. The reactions of methyl radicals are discussed in relation to the hypothesis of radical-mediated toxicity of halogenated compounds.

35301 **Radical anion of 1,1-difluoroethylene. EPR evidence for a perpendicular geometry.** Wang, J.T.; Williams, F. (Univ. of Tennessee, Knoxville). *Journal of the American Chemical Society ;* **103**: No. 10, 2902-2907(20 May 1981).

EPR spectra of the tetrafluoroethylene and 1-difluoroethylene radical anions were obtained. The EPR spectrum of $CF_2 = CH_2^-$ is interpreted in terms of a 90° twisted (perpendicular) molecular geometry with the unpaired electron occupying an orbital which can be designated as $\sigma^*$ (or $\pi'^*$) for the $CF_2$ group and $\pi$ for the $CH_2$ group. EPR spectra recorded from a $\gamma$-irradiated solution of $CF_2 = CH_2$ in methylcyclohexane-$d_{14}$ (MCHD) glass and 2-methyltetrahydrofuran glasses provided qualitative evidence for the formation of the 1,1-difluoroethylene radical anion, but lack of spectral resolution provided few clues about its structure. EPR studies in partially ordered, crystalline MCHD solutions showed a well-defined hyperfine structure. (BLM)

35302 **EPR detection of $(CF_3)_3Cl^-$. A test case regarding the stability of $RX^-$ radical anions.** Wang, J.T.; Willams, F. *Journal of the American Chemical Society ;* **102**: No. 8, 2860-2861(9 Apr 1980).

The presence of the radical anion $(CF_3)_3Cl^-$ was detected by the ESR analysis of a $\gamma$-irradiated solution of the compounds at 77 K in a 2-methyltetrahydrofuran glass. A reaction for its stability with respect to its dissociation modes ($R' + X$ or $R^- + X'$) is the extent to which the spin density is shared between the atomic orbitals of the localized three-electron bond with maximum stability attained for homonuclear diatomics such as $I^-$ and its congeners. The relative electronegativity is also a factor. 15 references, 1 figure.

## 4007 Radiochemistry And Nuclear Chemistry

*REFER ALSO TO CITATION(S) 34380, 34411, 35238*

35303 **(DOE/ER/01797—T1) Research in nuclear chemistry. Progress report, March 1, 1981-February 28, 1982.** Choppin, G.R. (Florida State Univ., Tallahassee (USA). Dept. of Chemistry). 1981. Contract AS05-76ER01797. 23p. (ORO—1797-98). NTIS, PC A02/MF A01. Order Number DE81030542.

Investigation of the properties of the actinide elements in aqueous solution continued. Analogous and complementary studies of lanthanide cations were conducted also. Potentiometry, calorimetry, solvent extraction, and nuclear magnetic resonance were the principal techniques. Evaluation of the thermodynamic values of complexation with series of alkyl dicarboxylate ligands provided understanding of the ring size for chelated complexes of these metals. Five- and-six membered chelate rings form but unless other geometrical features favor chelation, it does not seem to occur for ring sizes greater than seven. From a similar study of complexation with aromatic polycarboxylate lignas, transfer of negative charge through the pi system of the ligand enhanced the strength of complexation. Study of the $PuO_2^{+2}$-bicarbonate system showed that two species formed in the solutions. We assigned as these species $PuO_2(OH)(HCO_3)^{-1}$ and $PuO_2(CO_3)_2^{-2}$. In sea water, our results indicate that soluble Pu(VI) exists about equally as $PuO_2(OH)_2$ and $PuO_2(OH)_2(HCO_3)^{-1}$ with very little $PuO_2(CO_3)_2^{-2}$. This reflects a substantial difference from U(VI), as the dominant form in sea water is $UO_2(CO_3)^{-2}$. A significant achievement was the automation of the titration calorimeter. This allows simpler, and more sensitive operation. Techniques for studying the redox behavior of Pu(VI) and Np(V) in the presence of organic complexing ligands were developed and initial studies begun.

**35304 (K/ET—5025) Sorbent selection and design considerations for uranium trapping.** Schultz, R.M.; Hobbs, W.E.; Norton, J.L.; Stephenson, M.J. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jul 1981. Contract W-7405-ENG-26. 53p. NTIS, PC A04/MF A01. Order Number DE82000039.

The efficient removal of $UF_6$ from effluent streams can be accomplished through the selection of the best solid sorbent and the implementation of good design principles. Pressure losses, sorbent capacity, reaction kinetics, sorbent regeneration/uranium recovery requirements and the effects of other system components are the performance factors which are summarized. The commonly used uranium trapping materials highlighted are sodium fluoride, H-151 alumina, XF-100 alumina, and F-1 alumina. Sorbent selection and trap design have to be made on a case-by-case basis but the theoretical modeling studies and the evaluation of the performance factors presented can be used as a guide for other chemical trap applications.

**35305 (Y/DK—276) Infrared and structural analyses of uranium oxidation products: preliminary results.** Fuller, E.L. Jr.; Smyrl, N.R.; Eager, M.H.; Condon, J.B. (Oak Ridge Y-12 Plant, TN (USA)). Aug 1981. Contract W-7405-ENG-26. 60p. NTIS, PC A04/MF A01. Order Number DE82000233.

Water vapor oxidation of uranium follows a cyclic process: (1) rapid oxidation to form a thin dense, adherent layer of uranium dioxide, (2) slow diffusion of $H_2O$ and $H_2$ through this oxide, until (3) a thickness of 0.2 to 0.3 nm is achieved in a strained state that (4) relaxes from the surface allowing further (1) contiguous oxide formation and finally (5) the shards of oxide comprised of oxide laminae spall completely free of the metal surface. The oxide thus formed is hydrated on the surface. Diffuse reflectance infrared Fourier transform spectroscopy shows that these are several distinct modes of water binding delineated with respect to energetics and reversibility. Scanning electron microscopy aids immensely in defining the nature of the laminae. Implications and suggestions for further work are given to aid in a better understanding of corrosion processes.

**35306 Preparation and crystal structure of the 1,2-dimethoxyethane complex of bis[bis(trimethylsilyl)amido]dichlorouranium(IV).** McCullough, L.G.; Turner, H.W.; Andersen, R.A.; Zalkin, A.; Templeton, D.H. (Lawrence Berkeley Lab., CA). Contract W-7405-ENG-48. *Inorganic Chemistry ;* **20**: No. 9, 2869-2871(Sep 1981).

The complex $[(Me_3Si)_2N]_2UCl_2$(1,2-dimethoxyethane) has been prepared from uranium tetrachloride and 2 mol equiv of sodium bis(trimethylsilyl)amide in 1,2-dimethoxyethane. It may also be prepared from uranium tetrachloride and 2 mol equiv of sodium bis(trimethylsilyl)amide in tetrahydrofuran followed by addition of 1,2-dimethyoxyethane. The green pentane-soluble complex crystallizes in space group Pbca with cell dimensions a = 15.207 (4) A, b = 12.021 (3) A, and c = 33.427 (9) A, with Z = 8 and d/sub x/ = 1.57 g $cm^{-3}$. The uranium atom, with approximate $C_2$ local symmetry, is coordinated to two nitrogen atoms from the amide groups, two oxygen atoms from the dimethoxyethane group, and two chlorine atoms. The average U-N, U-O, and U-Cl distances are 2.23, and 2.59, and 2.64 A, respectively.

**35307 Preparation and hydrogen-deuterium exchange of alkyl and hydride bis(trimethylsilyl)amido derivatives of the actinide elements.** Simpson, S.J.; Turner, H.W.; Andersen, R.A. (Lawrence Berkeley Lab., CA). Contract W-7405-ENG-48. *Inorganic Chemistry ;* **20**: No. 9, 2991-2995(Sep 1981).

The monomeric, hydrocarbon-soluble monohydrides and monodeuterides of the actinide metals (thorium or uranium) of the type $HM[N(SiMe_3)_2]_3$ have been prepared. Their reaction chemistry - n-BuLi followed by MeBr yields $MeM[N(SiMe_3)_2]_3$ and borane in tetrahydrofuran yields $BH_4M[N(SiMe_3)_2]_3$ - suggests that the hydrogen atom is hydridic. Pyrolysis of the hydrides yields the novel, four-membered ring metallacycle $[(Me_3Si)_2N]_2M$ $CH_2Si(Me)_2NSiMe_3$ where M is Th or U. These metallacycles are the key intermediates in the hydrogen-deuterium exchange reaction that yields $([CD_3)_3Si]_2N)_3MD$.

**35308 Bis[$\pi$-(cyclobutenocyclooctatetraene)]uranium(IV).** Luke, W.D.; Berryhill, S.R.; Streitwieser, A. Jr. (Lawrence Berkeley Lab., CA). Contract W-7405-ENG-48. *Inorganic Chemistry ;* **20**: No. 9, 3086-3089(Sep 1981).

Bis[$\pi$-(cyclobutenocyclooctatetraene)]uranium(IV) was prepared by reaction of cyclobutenocyclooctatetraene dianion with $UCl_4$ and characterized by visible, IR, NMR, and mass spectra. The magnetic susceptibility shows Curie-Weiss dependence to 15 K and is temperature independent between 15 and 4.2 K. Variable-temperature $^1H$ NMR from -80 to +70°C as well as chemical trapping experiments show no evidence for opening of the cyclobutene ring to a quinodimethane moiety. The $^1H$ NMR spectrum is analyzed in terms of pseudocontact and contact contributions.

**35309 Thermal F/X atomic substitution reactions with methyl halides (X = Cl, Br, I).** Iyer, R.S.; Rowland, F.S. (Univ. of California, Irvine). Contract AT03-76ER-70126. *Journal of Physical Chemistry ;* **85**: No. 17, 2488-2492(20 Aug 1981).

The thermal substitution of F for X in $CH_3X$ (X = Cl, Br, I) at 283°K has been observed by using radioactive $^{18}F$ atoms moderated to thermal energies by multiple collisions in gaseous $SF_6$ at 3000 torr. The relative rate constants for these reactions have been measured in competition with addition to $C_2H_2$ and/or abstraction from HI, and have been converted to absolute rate constants by assuming a rate constant of $1.5_3 \times 10^{-10}$ $cm^3$ $molecule^{-1}$ $s^{-1}$ for F + $C_2H_2$. The rate constants for the thermal substitution of F/X in $CH_3X$ increase as the exothermicity of the replacement reaction increases, and have the following rate constants at 283°K, in units of $cm^3$ $molecule^{-1}$ $s^{-1}$: F + $CH_3I \rightarrow CH_3F$ + I, $k_6 = (8 +- 3) \times 10^{-13}$; F + $CH_3Br \rightarrow CH_3F$ + Br, $k_5 = (1.7 +- 0.3) \times 10^{-13}$; F + $CH_3Cl \rightarrow CH_3F$ + Cl, $k_4 = (3.7 +- 1.3) \times 10^{-14}$. In each case the abstraction of H from $CH_3X$ is very much faster than the substitution reactions.

**35310 Atom-transfer reaction rates for thermal fluorine atoms with $CH_3X$ and $CF_3X$ (X = Br, I).** Iyer, R.S.; Rowland, F.S. (Univ. of California, Irvine). Contract AT03-76ER-70126. *Journal of Physical Chemistry ;* **85**: No. 17, 2493-2497(20 Aug 1981).

The thermal reaction rates at 283°K of F atoms have been measured with $CH_3Br$, $CH_3I$, $CF_3Br$, and $CF_3I$ by use of radioactive $^{18}F$ atoms moderated to thermal energies by multiple collisions in gaseous $SF_6$ at a pressure of 2700 to 3000 torr. The relative rate constants for these reactions have been measured in competition with addition to $C_2H_2$ and/or abstraction from HI, and have been converted to absolute rate constants by comparison with the rate constant of $(1.53 +- 0.12) \times 10^{-10}$ $cm^3$ $molecule^{-1}$ $s^{-1}$ for the addition of F to $C_2H_2$. The thermal atom transfer to F of I from $CF_3I$, of I and/or H from $CH_3I$, and of H from $CH_3Br$ are all extremely rapid. No reaction was observed with $CF_3Br$. The absolute rate constants measured in competition with F addition to $C_2H_2$ are (in

units of $cm^3$ $molecule^{-1}$ $s^{-1}$) as follows: F + $CH_3Br$ → HF + $CH_2Br$, $k_6$ = (6.1 +- 0.7) x $10^{-11}$; F + $CH_3I$ → HF + $CH_2I$, F + $CH_3I$ → IF + $CH_3$, $k_8$ + $k_9$ = (1.74 +- 0.15) x $10^{-10}$; F + $CF_3I$ → IF + $CF_3$, $k_7$ = (1.62 +- 0.16) X $10^{-10}$.

**35311 Syntheses and characterization of (eta$^5$-$C_5H_5)_2U(NR_2)_2$ compounds.** Arduini, A.L. (Lawrence Berkeley Lab., CA); Edelstein, N.M.; Jamerson, J.D.; Reynolds, J.G.; Schmid, K.; Takats, J. Contract W-7405-ENG-48. *Inorganic Chemistry ;* **20**: No. 8, 2470-2474(Aug 1981).

The reaction of 2 equivalents of cyclopentadiene with $U(NPr_2)_4$ and $U(NPh_2)_4$ and the reaction of 1.5 equivalents of cyclopentadiene with $U(NEt_2)_4$, generated in situ, gives the corresponding $Cp_2U(NR_2)_2$ complexes in good yields. However, U(N-i-$Pr_2)_4$ does not react with cyclopentadiene at room temperature and $U(NMe_2)_4$ gives mixture of $Cp_2U(NMe_2)_2$ and $Cp_3U(NMe_2)$. Excess cyclopentadiene also reacts with $Cp_2U(NEt_2)_2$ to produce $Cp_3U(NEt_2)$. The transamination reaction of $Cp_2U(NEt_2)_2$ with pyrrole and 2,3-dimethylpyrrole gives mixtures of products only; however, ethyl 3,4,5-trimethylpyrrole-2-carboxylate gives $Cp_2U[NC_4Me_3(COOEt)]_2$, and the reaction with 1 equivalent of diphenylamine yields $Cp_2U(NEt_2)(NPh_2)$. It is argued that the reactivity sequence and the stability of $Cp_2U(NR_2)_2$ compounds are best explained by steric effect considerations. The spectral characteristics of the $Cp_2U(NR_2)_2$ complexes are presented which show that the compounds possess eta$^5$-cyclopentadienyl moieties and monomeric solution behavior with no primary solvent interaction. In $Cp_2U[NC_4Me_3(COOEt)]_2$, additional interaction between uranium and oxygen of the carboxylate functionality is postulated.

**35312 Re-interpretation of the vapor pressure measurements over $UF_5$.** Leitnaker, J.M. (Oak Ridge Gaseous Diffusion Plant, TN). Contract W-7405-ENG-26. *High Temperature Science ;* **12**: No. 4, 289-296(Dec 1980).

A statistical analysis of literature data on the vapor transport of $UF_5$ indicates an influence of the pressure of $UF_6$ on the transport of $UF_5$. The most likely explanation appears to be a $U_2F_{11}$ gaseous molecule. Both the enthalpy and entropy calculated for vaporization of $UF_5$ are changed by this treatment.

**35313 Unusually high (oxidizer/Pu) ratios in the macroresidues from plutonium-droplet combustion.** Nelson, L.S. (Sandia National Labs., Albuquerque, NM). *High Temperature Science ;* **12**: No. 4, 297-303(Dec 1980).

Individual submillimeter-diameter droplets of $^{239}$Pu-0.6w/o Ga alloy were laser ignited and burned during free fall through air. As with a number of other active metals, plutonium droplets burn as coherent, intensely incandescent bodies that explode near the end of combustion. Compared to many other metals, however, the explosive event with plutonium droplets is relatively mild, and, in most experiments, an essentially intact spherule of oxidized material can be retrieved afterward from the combustion chamber. The oxidizer-to-plutonium atomic ratios (O/Pu) of the exploded spherules retrieved in the experiments seem unusually high - from 3- to 5-fold greater than the pre-explosion ratios. Some possible explanations of the high apparent O/Pu ratios are: (1) the particles may have become contaminated after the explosion but before the microweighing; (2) the analyses may have been performed with only partially dissolved specimens; (3) one or more elements heavier than the oxidizer elements (i.e. Ga) may have concentrated in the post explosion residue, giving a false indication of the O/Pu ratio; (4) the specimens may be supersaturated or otherwise metastable solutions of oxygen or other oxidizers quenched in at combustion temperatures; or (5) there might be hitherto unknown hyperstoichiometric oxygen and/or nitrogen compounds of plutonium which form at high temperatures. (JMT)

**35314 Method for selectively removing fluorine and fluorine-containing contaminants from gaseous $UF_6$.** Jones, R.L.; Otey, M.G.; Perkins, R.W. (to to Dept. of Energy). US Patent Application 209,920. 24 Nov 1980. 9p.

This invention is a method for effecting preferential removal and immobilization of certain gaseous contaminants from gaseous $UF_6$. The contaminants include fluorine and fluorides which are more reactive with $CaCO_3$ than is $UF_6$. The method comprises contacting the contaminant-carrying $UF_6$ with particulate $CaCO_3$ at a temperature effecting reaction of the contaminant and the $CaCO_3$.

**35315 Current status of the transuranium processing plant.** King, L.J. (Oak Ridge National Lab., TN). *Proceedings of the Conference on Remote Systems Technology ;* 96-102(1979).

The primary mission of the Transuranium Processing Plant (TRU) continues to be the production of transuranium elements for research. Improvements in chemical processes, process equipment, operating techniques, and feed materials have made it unnecessary to operate at full capacity to satisfy the needs of the heavy-element research community. About 25% of the total effort at TRU is now being devoted to other programs. 6 figures.

### 4008 Combustion, Pyrolysis, And High-temperature Chemistry

**35316 (UCRL—86456) Flame inhibition by methyl bromide.** Westbrook, C.K. (Lawrence Livermore National Lab., CA (USA)). 27 Aug 1981. Contract W-7405-ENG-48. 34p. (CONF-811041—1). NTIS, PC A03/MF A01. Order Number DE81030995.

From Western States Section meeting of the Combustion Institute; Tempe, AZ, USA (19 Oct 1981).

A numerical flame model is used to investigate the inhibition of laminar hydrocarbon-air and hydrocarbon-oxygen flames by methyl bromide, $CH_3Br$. The detailed kinetic mechanism consists of 97 elementary reactions involving 30 chemical species and is based on a previous model for flame inhibition by HBr to which have been added reactions in which Br atoms are abstracted from $CH_3Br$. The resulting mechanism is validated by comparison between experimental data on low pressure $CH_4$-$O_2$-$CH_3Br$ flames. Subsequently, the model is used to predict the response of a series of fuel-air mixtures to the addition of varying amounts of $CH_3Br$. Fuels considered include methane, methanol, and ethylene. It is found that the inhibition efficiency depends on fuel-air equivalence ratio, pressure and fuel type. The kinetic factors responsible for this behavior are discussed in detail.

**35317 Combustion of alternative fuels.** Ruether, J.J.; Daley, R.D.; Kim, H.T.; Macey, C.J.; Ogunsola, O.I.; Taylor, P.H.; Warchol, J.J.; Withum, J.A.; Yinn, K.C. (Pennsylvania State Univ., University Park). pp 23a-60a of Proceedings of third annual energy seminar. Erie, PA; Gannon University (1981).

From 3. annual energy seminar; Erie, PA, USA (31 Mar 1981).

A research program is being conducted to achieve a better understanding of how the composition of natural and synthetic, fossil and nonfossil fuels relate to their combustion behaviors and pollution. The approach taken in the program is to burn, probe, and analyze a variety of fuels in combustors. Combustion of the following fuels is being studied: coal (bituminous, anthracite), reconstituted coal (SRC-1, gasifier char), wood, petroleum crude, refined fuel oils, coal liquids, shale oil, tar sand, and fuel gas (NG, syngas). 34 figures. (DLC)

## 42 ENGINEERING

### 4202 Facilities And Equipment

*REFER ALSO TO CITATION(S) 34258, 34263, 34269, 34694, 34701, 34997, 35203, 35205, 35734*

**35318 (ANL—81-51) Buckling of a thin initially wrinkled rectangular plate.** Matkowsky, B.J.; Putnick, L.J.; Reiss, E.L. (Argonne National Lab., IL (USA)). Aug 1981. Contract W-31-109-ENG-38. 19p. NTIS, PC A02/MF A01. Order Number DE81029963.

The deformation of a thin elastic plate which is initially wrinkled when the plate is subjected to a constant compressive end thrust is considered. The singularly perturbed bifurcation theory of Reiss and Matkowsky is used. It is found that the initial deformation (imperfection) of the plate leads to solutions which explain the experimentally observed decrease in the buckling load from that predicted by bifurcation theory and the smooth transition to a buckled solution.

35319 **Fabrication of large surface mining machinery.** Learmont, T. (Bucyrus-Erie Co., South Milwaukee, WI). *Welding Journal (Miami) ;* **56**: No. 1, 20-25(Jan 1977).

From 22. Midwest welding conference; Madison, Wisconsin, USA (12 Oct 1976).

In the past 3 years, there has been an explosive growth in the demand for surface mining machinery throughout the world. Surface mining falls into two types: open pit and overcasting. A brief review of overcasting equipment is given, i.e., wheel excavators, stripping shovels, and walking draglines. Considerations to be taken in the design of welded joints are discussed, and the fabrication of some dragline components is examined. Some of the welding procedures used are described briefly. (DLC)

35320 **(LA—8683-MS) Preliminary tests of overburden-material filtration and the capture-bag concept.** Horak, H.L.; Gregory, W.S.; Smith, P.R.; Beckett, M.A. (Los Alamos National Lab., NM (USA)). Jul 1981. W-7405-ENG-36. 29p. NTIS, PC A03/MF A01. Order Number DE81032027.

The experimental work described was performed to provide test data for the Nuclear Emergency Search Team (NEST) Damage Limitation Working Group. These preliminary tests explored techniques of shock absorption and aerosol filtration under transient airflow conditions. Two types of experiments were run using two separate apparatus. Nylon fabric capture bags were structurally tested on a small shock tube, and various filter media were tested for steady-state aerosol filtration efficiency during high pressure drops using a blowdown tube.

35321 **(SAND—80-1879) Development of analytical tools for the punch investigation of the transuranic package transporter (TRUPACT).** Sutherland, S.H.; Duffey, T.A. (Sandia National Labs., Albuquerque, NM (USA)). May 1981. Contract AC04-76DP00789. 58p. NTIS, PC A04/MF A01. Order Number DE82000820.

Methods of simplified analysis are presented for the evaluation of the punch resistance of the TRUPACT sidewalls. The first method consists of an elastic analysis of a foam-backed triangular plate. This analysis, which accurately models the geometry of the TRUPACT sidewall (though not the material behavior) is then used to evaluate the influence of the particular location on the sidewall where the punching is taking place. The second method consists of a plastic membrane analysis of a circular plate in which both the plate material and foam backing exhibit plastic behavior. In this analysis, the material behavior of the TRUPACT is accurately modeled, whereas the geometry is not. This analysis is used to estimate the minimum thickness of the foam-backed outer skin required to prevent its perforation.

35322 **(SAND—80-2303) Evaluation of three partially volatile neutron shields for high-performance shipping casks.** Rack, H.J.; Pearson, H.S. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1981. Contract AC04-76DP00789. 41p. (TTC—0149). NTIS, PC A03/MF A01. Order Number DE82000245.

The thermal stability and mechanical behavior of three partially volatile candidate neutron shield materials have been evaluated. The results indicate that silicone based rubbers, impregnated with elemental boron or boron carbide, Boro-silicone 236 and Bisco NS-I respectively are more thermally stable than are borated beechwoods, e.g., Permali JN. Mechanical property measurements indicated however that the compressive strength of the borated beechwood is 10 to 48 times higher than that of the silicone-based rubbers. The compressive strengths of the borated beechwood and boron carbide impregnated silicone rubber were substantially more sensitive to test temperature than was the compressive strength of the boron impregnated silicone rubber. Finally the compressive strengths and energy absorbing capability of the boron impregnated silicone rubber is not affected by prior thermal exposure at 425°K for 1000h.

35323 **(SAND—81-1365C) Investigations of puncture resistance of a soft type-B container.** Duffey, T.A.; May, R.A.; Sutherland, S.H. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 8p. (TTC—0224; CONF-811103—1). NTIS, PC A02/MF A01. Order Number DE81023929.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

This paper summarizes the investigations performed to evaluate the puncture resistances of a new soft Type B container. This container is known as the TRansUranic PACkage Transporter (TRUPACT). The TRUPACT is a large container (7.3m x 2.7m x 3.0m) consisting of inner and outer tubular steel space frames which are separated by rigid polyurethane foam.

35324 **(SAND—81-1417C) Evaluation of proposed methods of radioactive material container tie-down design for truck transport.** Lamoreaux, G.H. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 4p. (TTC—0225; CONF-811103—2). NTIS, PC A02/MF A01. Order Number DE81024032.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

The following conclusions were drawn from this study: casks over 9100 kg in mass and their restraining systems can be considered rigid in the vertical direction for the lower modes of vibration. Vehicle bed accelerations for truck transportation system vary significantly from system to system. Vehicle bed accelerations of additional systems need to be measured before a general design guide can be provided. Simple, cost efficient tests are being conducted that will provide the data necessary for adequate guidance to the design of tie-downs for large shipping containers.

35325 **(Y—2249) Control systems improvements in a precision coordinate measuring machine.** Douglass, S.S.; Babelay, E.F. Jr.; Igou, R.E.; Woodard, L.M.; Green, W.L. (Oak Ridge Y-12 Plant, TN (USA); Tennessee Univ., Knoxville (USA)). Sep 1981. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01. Order Number DE82000024.

A conventional, manually driven Moore No. 3 coordinate-measuring machine at the Oak Ridge Y-12 Plant is being upgraded to provide a continuous-path numerical control capability and simultaneously serve as a vehicle for testing new machine slide-control concepts. Besides new lead screw drive motors, an NC machine control unit, and a closed-loop servo system, the machine has also been equipped with vibration isolation, air-bearing slideways, and laser interferometric position feedback. The present conventional slide servo system will be replaced with a digital servo system wherein various feedback and compensation techniques can be realized through the use of a high-speed, dedicated digital processor. This report describes the improvements to date with emphasis on identification and compensation of the slide control systems.

35326 **Model test coil for a 10 MVA superconducting generator field winding.** Minervini, J.V.; Tepper, K.A.; Smith, J.L. Jr. (MIT, Cambridge, Mass). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-17**: No. 1, 123-126(Jan 1981). (CONF-800980—).

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

The superconducting field winding of the MIT-DOE 10 MVA experimental generator has been designed using a unique structural concept of 14 discrete saddle shapdd winding modules supported by a series of yokes. Intramodule stresses are minimized by interlayer slip planes. A model coil has been built to develop the fabrication techniques for the generator field winding. The coil was constructed to the full scale dimensions of one of the field winding modules, but in a solenoidal geometry to fit the test facility. The coil has been tested under simulated operating conditions to prove the viability of the design concept and to measure the electrical and thermal performance of the winding. 4 rfs.

35327 **Mechanical and helium cooling factors in dipole magnet training.** Caspi, S.; Gilbert, W.; Hassenzahl, W.; Lambertson, G.; Meuser, R.B.; Rechen, J.B.; Schafer, R.; Warren, R.P. (Univ of Calif, Berkeley). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-17**: No. 1, 443-446(Jan 1981). (CONF-800980—).

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

The roles of prestress, friction and cooling in the alleviation of the problem of training in superconducting dipole magnets were investigated. An analysis of the Lorentz force and its influence on

variously pre-stressed coils is presented. Mechanical tests have been made on typical coil materials. Material characteristics are used in the calculation of the coil pre-stress level attained in several magnets. The training behavior of these magnets is shown to depend on the coil pre-stress level attained, although the prediction is more pessimistic than the actual performance. The beneficial influence of enhanced heat removal in superfluid helium-II is demonstrated. 4 refs.

35328 **Enthalpy stability criterion for magnets cooled with superfluid helium II.** Van Sciver, S.W. (Univ of Wis, Madison). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-17**: No. 1, 747-749(Jan 1981). (CONF-800980—).

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

A criterion is presented which describes the limits to local heat pulses sustained by a magnet cooled in superfluid helium II. The magnet will remain stable for a length of time defined by the enthalpy of the helium between bath temperature and the maximum superfluid temperature. For a bath temperature of 1.8 K, this enthalpy is 300 MJ/cm$^3$. For long pulses, the volume of helium that absorbs the heat can be considered to approach the contents of the entire dewar. For short heat pulses, there is a limited region into which the heat diffuses. This diffusion process can be defined using experimental results on transient heat transfer. A model is presented to describe how to generalize the thermal diffusivity in superfluid helium II. Application of this criterion to specific magnets is discussed. 7 refs.

35329 **Care and training of superconducting magnets.** Tollestrup, A.V. (Fermilab, Batavia, Ill). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-17**: No. 1, 863-872(Jan 1981). (CONF-800980—).

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

The term training refers to the increase of peak current observed in a magnet when it undergoes a series of tests where the current is ramped up until the magnet quenches. Theories and experiments related to training are considered. Design guidelines of superconducting magnets are outlined. 15 refs.

35330 **Summary data from large scale quality control tests on superconducting wire.** Fowler, W.B.; Kuchnir, M.; Flora, R.H.; Remsbottom, R.H. (Fermilab, Batavia, Ill). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-17**: No. 1, 925-926(Jan 1981). (CONF-800980—).

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

The construction of superconducting magnets for the Energy Saver Synchrotron caused the procurement by Fermilab of 3 x 10$^7$ m of multifilamentary NbTi wire. This .68 mm diam wire is composed of approximately 2 x 10$^3$ filaments of 8$\mu$ diam in a copper matrix with 1.8:1 copper to superconductor ratio. A previous publication describes how lengths of this wire are managed for the manufacture of a 23-wire cable of the Rutherford type use in the winding. In this paper, results are presented of short sample tests on these wires by the manufacturer for every half billet (/approximately equals/5 x 10$^4$m) and by Fermilab on the cables for every reel to be used in a magnet.

35331 **Generation of high-power microwave pulses using a spherical superconducting cavity and interference-type switch.** Alvarez, R.A.; Birx, D.; Byrne, D.; Mendonca, M.; Johnson, R.M. (Lawrence Livermore Lab, Calif). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-17**: No. 1, 935-938(Jan 1981). (CONF-800980—).

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

150 kW pulses of 2 $\mu$/s duration were generated at 8.2 GHz by rapidly dumping the energy stored in a nearly spherical superconducting cavity. The cavity was constructed of copper and electroplated with lead. A small geometrical perturbation was introduced to define a polar axis and suppress some unwanted modes. The mode excited was a fairly pure $TE_{920}$ mode. Intrinsic Q values greater than 10$^9$ were achieved at 1.7 K, which allowed an energy accumulation of /approximately equals/0.3 J with a drive power of about 300 W. Energy input and pulse extraction were achieved through a single aperture coupled to a rectangular waveguide by an interference type switch and variable coupler. 8 refs.

35332 **Mechanical and heat transfer models for frictional heating in superconducting coils.** Tepper, K.A. (MIT, Cambridge, Mass). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-17**: No. 1, 1060-1063(Jan 1981). (CONF-800980—).

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

Some mechanisms which can cause slip in superconducting coils are identified. Simple worst case elasticity models are developed which predict the magnitude of the relative motions and the frictional heat generated. A general heat transfer model is presented which predicts temperature rises in the superconductors. The model is applicable to superconducting windings with turn-to-turn insulation, where the slip occurs at an insulation-to-insulation interface. The model assumes the slip occurs in zero time in order to take into account the possibility of "stick-slip". 7 refs.

35333 **Metastable superconductive composites: dependence of stability on copper-to-superconductor ratio.** Elrod, S.A.; Lue, J.W.; Miller, J.R.; Dresner, L. (Oak Ridge Natl Lab, Tenn). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-17**: No. 1, 1083-1086(Jan 1981). (CONF-800980—).

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

The stability of composite superconductors operating in the metastable regime depends upon such factors as matrix resistivity, cooled surface dimensions, fraction of critical current, and volume fraction of stabilizer. By assuming constant thermophysical properties, analytic expressions were developed for the energy and voltage of the minimum propagating zone (MPZ). With other factors held constant, these expressions have been used to predict composite superconductor stability as a function of copper fraction; lower copper fractions lead to higher MPZ energies. MPZ voltages have been measured for three NbTi/Cu composites having different copper fractions and different critical current densities for several magnetic fields and transport currents. Experimental MPZ voltages have been used to calculate an effective heat transfer coefficient, which is subsequently used to calculate the MPZ energy. 5 refs.

35334 **Optical fuel pin scanner.** Kirchner, T.L.; Powers, H.G. (to Dept. of Energy). US Patent Application 214,805. 9 Dec 1980. 8p.

This patent relates to an optical identification system developed for post-irradiation disassembly and analysis of fuel bundle assemblies. The apparatus is designed to be lowered onto a stationary fuel pin to read identification numbers or letters imprinted on the circumference of the top fuel pin and cap. (DLC)

35335 **Superconducting VAR control.** Boenig, H.J.; Hassenzahl, W.V. (to Dept. of Energy). US Patent Application 213,275. 5 Dec 1980. 15p.

Static VAR control means are described employing an asymmetrically controlled Graetz bridge and a superconducting direct current coil having low losses and low cost characteristics.

35336 **Laser weld jig.** Van Blarigan, P.; Haupt, D.L. (to Dept. of Energy). US Patent Application 213,267. 5 Dec 1980. 8p.

A system is provided for welding a workpiece along a predetermined weld line that may be of irregular shape, which includes the step of forming a lip on the workpiece to extend parallel to the weld line, and moving the workpiece by engaging the lip between a pair of rotatable members. Rotation of one of the members at a constant speed, causes the workpiece to move so that all points on the weld line sequentially pass a fixed point in space at a constant speed, so that a laser welding beam can be directed at that fixed point to form a weld along the weld line. The workpiece can include a reusable jig forming the lip, and with the jig constructed to detachably hold parts to be welded at a position wherein the weld line of the parts extends parallel to the lip on the jig.

35337 **Control system to reduce the effects of friction in drive trains of continuous-path-positioning systems.** Green, W.L. (to Dept. of Energy). US Patent Application 212,045. 1 Dec 1980. 10p.

An improved continuous-path-positioning servo-control system is provided for reducing the effects of friction arising at very low cutting speeds in the drive trains of numerically controlled cutting machines, and the like. The improvement comprises a feed forward network for altering the gain of the servo-control loop at low positioning velocities to prevent stick-slip movement of the cutting tool holder being positioned by the control system. The feed forward network shunts conventional lag-compensators in the control loop, or loops, so that the error signal used for positioning varies linearly when the value is small, but being limited for larger values. Thus, at higher positioning speeds there is little effect of the added component upon the control being achieved.

35338 **Alarm toe switch.** Ganyard, F.P. (to Dept. of Energy). US Patent Application 208,099. 18 Nov 1980. 16p.

An alarm toe switch inserted within a shoe for energizing an alarm circuit in a covert manner includes an insole mounting pad into which a miniature reed switch is fixedly molded. An elongated slot perpendicular to the reed switch is formed in the bottom surface of the mounting pad. A permanent cylindrical magnet positioned in the forward portion of the slot with a diameter greater than the pad thickness causes a bump above the pad. A foam rubber block is also positioned in the slot rearwardly of the magnet and holds the magnet in normal inoperative relation. A non-magnetic support plate covers the slot and holds the magnet and foam rubber in the slot. The plate minimizes bending and frictional forces to improve movement of the magnet for reliable switch activation. The bump occupies the knuckle space beneath the big toe. When the big toe is scrunched rearwardly the magnet is moved within the slot relative to the reed switch, thus magnetically activating the switch. When toe pressure is released the foam rubber block forces the magnet back into normal inoperative position to deactivate the reed switch.

35339 **Long-life leak standard assembly.** Basford, J.A.; Mathis, J.E.; Wright, H.C. (to Dept. of Energy). US Patent Application 206,222. 12 Nov 1980. 10p.

The present invention is directed to a portable leak standard assembly which is capable of providing a stream of high-purity reference gas at a virtually constant flow rate over an extensive period of time. The leak assembly comprises a high pressure reservoir coupled to a metal leak valve through a valve-controlled conduit. A reproducible leak valve useful in this assembly is provided by a metal tube crimped with a selected pressure loading for forming an orifice in the tube with this orifice being of a sufficient size to provide the selected flow rate. The leak valve assembly is formed of metal so that it can be baked-out in a vacuum furnace to rid the reservoir and attendent components of volatile impurities which reduce the efficiency of the leak standard.

## 4203 Lasers

*REFER ALSO TO CITATION(S) 34352, 35354, 35760*

35340 **(UCRL—86617) Diagnostic device for bunched electron beams.** Garrison, J.C.; Szoke, A. (Lawrence Livermore National Lab., CA (USA)). 19 Aug 1981. Contract W-7405-ENG-48. 20p. (CONF-8106145—3). NTIS, PC A02/MF A01. Order Number DE82000639.

From 1981 workshop on free electron lasers; Sun Valley, ID, USA (22 Jun 1981).

The operation of free electron lasers depends crucially on the bunching of the electron beam; it must be precisely modulated at the desired laser frequency, and it must occupy a narrow energy centered on a resonant electron energy. A method for measuring these properties directly by steering the e-beam through a properly designed wiggler magnet and observing the emitted radiation is proposed. This kind of device is closely related to the optical klystron, and it is expected that such devices will be important for understanding and improving the operation of FEL's, especially those with low gain.

35341 **(Y—2208) Production interferometric testing of diamond-turned surfaces.** Sladky, R.E. (Oak Ridge Y-12 Plant, TN (USA)). Sep 1981. Contract W-7405-ENG-26. 30p. NTIS, PC A03/MF A01. Order Number DE82000172.

Some of the optical interferometric tests that are used to examine the figure of diamond-turned optics are described. Some tests are routine, and the results can be statistically examined to measure the repeatability of the testing process. It was first necessary to analyze the interferograms to obtain the rms or peak-to-valley errors and the optical aberrations. From these data, the repeatability of the interferometric procedure was obtained. Tests showed that a single interferogram could be digitized repeatedly with excellent precision, but a series of interferograms was affected by the changing environmental conditions. Also, the precision measurements of a plated mirror over a period of time were affected by the variations in the temperatures of the mirror.

35342 **Long-pulse, broadband-Xe($_2$ -fluorescence excitation of OCSe: Initiation of the Se($^1$S→$^3$P) laser and implications for large-system design.** Trott, W.M.; Woodworth, J.R.; Rice, J.K.; Miller, C.K. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics ;* **52**: No. 9, 5811-5819(Sep 1981).

The formation and loss of Se($^1$S) excited states have been examined using long-pulse (0.7—1.0 μsec), broadband (13 nm FWHM)-Xe($_2$- fluorescence photodissociation of carbonyl selenide. Experimental data are compared to results of a computer code that models the Xe($_2$ radiation transport and Se($^1$S) kinetics. The effective quantum yield for Se($^1$S) production over the wavelength interval 160—180 nm has been found to be near 0.6. The observed Se($^1$S) decay rates have been used in conjunction with the code to predict the effects of excitation pulse length on the efficiency of the selenium laser system. Laser oscillation has been demonstrated for the Se($^1S_0$→$^3P_1$) transition in a long-active-length (54 cm) optical cavity. Oscillator performance was characterized as a function of OCSe pressure. The optimized laser output was 1.3 mJ, a value consistent with the Se($^1$S) kinetics and laser cavity conditions.

35343 **Attainment of the theoretical minimum input power for injection locking of an unstable-resonator KrF laser.** Bigio, I.J.; Slatkine, M. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Optics Letters ;* **6**: No. 7, 336-338(Jul 1981).

We report attaining a ratio of output to injected power as high as $10^8$ in a KrF system, the limit being reached when injected power equals the noise per mode in the resonator. We find that, because of coherence effects, adjustment of the cavity length for correct value of the equivalent Fresnel number can change the threshold power for frequency locking by at least 2 orders of magnitude. The laser's locked bandwith is <0.1A, and the line can be turned over a range exceeding 10 A. The beam divergence is near (i.e. 1.5 x ) the diffraction limit.

35344 **Control of mode behavior in semiconductor lasers.** Wang, S.; Chen, C.Y.; Liao, A.S.H.; Figueroa, L. (Univ of Calif, Berkeley). *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics ;* **QE-17**: No. 4, 453-468(Apr 1981).

Aspects important to lateral-mode stability and single longitudinal-mode operation in the index-guided semiconductor lasers are examined and analyzed. These include the modal properties of the guiding structure and the current distribution in the active region. Waveguiding mechanisms in various structures are analyzed and approximate expressions for the number of lateral modes are obtained. Possible modes in rectangular dielectric waveguides are presented and discussed. The problems of nonsatisfaction of the boundary condition and ambiguity in the field polarization are pointed out. A discussion is presented of the factors affecting lateral-mode stability and single longitudinal-mode operation. It is shown that a positive gain difference /DELTA/g must be maintained in the lateral direction for lateral-mode stability, even though a positive index different /DELTA/n exists. The effect of nonuniform gain on longitudinal modes is examined. It is shown that a ten percent variation in carrier concentration can result in a shift in peak-gain wavelength about 25 A. 50 refs.

35345 **Multiple pass stimulated Raman conversion with pump depletion.** Kung, R.T.V. (W.J. Schafer Assoc Inc, Wakefield, Mass). *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics ;* **QE-17**: No. 4, 509-513(Apr 1981).

An analytical expression is derived for the efficiency of stimulated Raman conversion applicable to Gaussian pump and Stokes beams in a multiple-pass cell. Pump depletion and mirror reflectivity are taken into account. The result provides a simple expression for calculating the conversion efficiency versus the number of passes through a Raman cell. It is especially useful in the design of multiple-pass cells for infrared Raman conversion in which the gain is low and many passes are required. 14 refs.

## 4204 Heat Transfer And Fluid Flow

*REFER ALSO TO CITATION(S) 34232, 34703, 34704, 34705, 34706, 34779, 34784, 34785, 34786, 34796, 34812, 34869, 34891, 34894, 34907*

35346 **(UCRL—52972) Formulas for one-dimensional local properties for molecular-dynamics simulations of shock waves.** Hardy, R.J. (Lawrence Livermore National Lab., CA (USA)). 8 Jan 1981. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01. Order Number DE82000906.

Formulas are derived for the mass, momentum, and energy densities, the xx component of the pressure tensor P/sup xx/, and the x component of the heat flux Q/sup x/. The formulas relate these local properties to the masses, positions, and velocities of the constituent particles making up the system and are in a usable form for molecular-dynamics simulations without approximation. The formulas for P/sup xx/ and Q/sup x/ avoid the infinite series found in the formulas of Irving and Kirkwood.

35347 **Multiphase transport: fundamentals, reactor safety, applications (proceedings of the multi-phase flow and heat transfer symposium-workshop), 1979.** Veziroglu, T.N. (ed.). Washington, DC; Hemisphere Publishing Corp. (1979). 2932p. (CONF-790423—).

From 2. multiphase flow and heat transfer symposium workshop; Miami Beach, FL, USA (16 Apr 1979).

This conference is published in 5 volumes and contains 134 papers, 133 of which are abstracted separately. The subject matter is concerned with various aspects of multiphase flow systems. The topics covered include multiphase phenomena, mathematical modeling, boiling, condensation, heat and mass transfer, reactor safety gas/particle systems and fluidized beds. A 1979 publication of extended abstracts of symposium papers was indexed in the March 1980 Engineering Index Monthly.

## 4207 Vacuum Engineering

35348 **(BNL—30100) Air desorption from a water film.** Edwards, D. Jr. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 7p. (CONF-811113—15). NTIS, PC A02/MF A01. Order Number DE81031961.

From American Vacuum Society national symposium; Anaheim, CA, USA (3 Nov 1981).

The thermal desorption of air cryotrapped in a water film is reported. In addition, the non-effect of pure water overlayers is observed. The practical implication is that this type of system could be able to be used as a pump of air in a vacuum system.

35349 **(SAND—81-1452C) Methods for calibration of standard leaks.** Iverson, M.V.; Hartley, J.L. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1981. Contract AC04-76DP00789. 14p. (CONF-811113—3). NTIS, PC A02/MF A01. Order Number DE81030211.

From American Vacuum Society national symposium; Anaheim, CA, USA (3 Nov 1981).

The Sandia Laboratories Standards Department is currently using the comparison, PΔV and accumulate-dump methods to calibrate standard leaks. The comparison method may be used in the range from $10^{-5}$ to $10^{-8}$ atm cm$^3$/s with a maximum uncertainty of 10%. The PΔV method can be used for fundamental calibration of faster leaks in the range from $10^{-3}$ to $10^{-5}$ atm cm$^3$/s with a maximum uncertainty of 5%. Finally the accumulate-dump method can be used to fundamentally calibrate leaks in the range from $10^{-4}$ to $10^{-10}$ atm cm$^3$/s with uncertainties ranging from 5 to 20%. Thus the purpose of this paper is to introduce three calibration methods with an analysis of the errors involved. These methods are reviewed and compared with other leak calibration methods currently in use.

## 4208 Electronic Circuits And Devices

*REFER ALSO TO CITATION(S) 35365*

35350 **(BDX—613-2683) Characterization and comparison of thermistor thick films. Topical report.** Gehman, R.W. (Bendix Corp., Kansas City, MO (USA)). Sep 1981. Contract AC04-76DP00613. 56p. NTIS, PC A04/MF A01. Order Number DE82000831.

Four thermistor thick film inks were evaluated for HMC production use. The physical, chemical and electrical properties of the wet inks and fired films were measured. Variations in the physical and chemical properties of the inks were used to explain variations in thermistor electrical resistance and temperature coefficient of resistance.

35351 **(BNL—51420) Meaning of the negative impedance.** Conciauro, G.; Puglisi, M. (Brookhaven National Lab., Upton, NY (USA)). Jun 1981. Contract AC02-76CH00016. 7p. NTIS, PC A02/MF A01. Order Number DE81030830.

It is shown that the negative real part of an input impedance does not mean instability of the related circuit. A negative real part of the input impedance means only that the concerned circuit is active.

35352 **(LBL—12303) Microcomputer based test system for charge coupled devices.** Sidman, S. (Lawrence Berkeley Lab., CA (USA)). Feb 1981. Contract W-7405-ENG-48. 6p. (CONF-811115—1). NTIS, PC A02/MF A01. Order Number DE81029860.

From IEEE conference on applications of mini and microcomputers; San Francisco, CA, USA (9 Nov 1981).

A microcomputer based system for testing analog charge coupled integrated circuits has been developed. It measures device performance for three parameters: dynamic range, baseline shift due to leakage current, and transfer efficiency. A companion board tester has also been developed. The software consists of a collection of BASIC and assembly language routines developed on the test system microcomputer.

35353 **(SAND—81-8028) SALOGS4 user and plot manual, Sandia National Laboratories, Livermore.** Miller, G.J.; Soderstrand, M.A. (Sandia National Labs., Livermore, CA (USA)). Sep 1981. Contract AC04-76DP00789. 74p. NTIS, PC A04/MF A01. Order Number DE82000832.

SALOGS4 is the most recent version of the Sandia logic circuit simulation program written for the PDP-10 system at Sandia Albuquerque. The authors have added a flexible plot program which considerably increases the capability of the SALOGS4 program. SALOGS4 supports the simulation of digital circuits containing any of the basic logic gates. It further has an extensive permanent library of logic models consisting of various combinations of logic gates which properly model digital devices such as flip-flops, registers, multiplexers, and many others. SALOGS4 also allows the user to define both logic models (such as are found on the permanent library) and functional models which model the input/output modeled by basic gates or for which the user chooses only to model the input/output characteristics. The plotting feature allows the user to obtain detailed timing diagrams of any nodes or set of nodes within the circuit. Each plot will have a user provided annotation and the date and time the simulation was carried out. Once plotted, data may be replotted with different arrangement of nodes and for different time ranges without re-simulating the networks.

35354 **Device for detecting imminent failure of high-dielectric stress capacitors.** McDuff, G.G. (to Dept. of Energy). US Patent Application 204,121. 5 Nov 1980. 14p.

A device is described for detecting imminent failure of a high-dielectric stress capacitor utilizing circuitry for detecting pulse width variations and pulse magnitude variations. Inexpensive microprocessor circuitry is utilized to make numerical calculations of digital data supplied by detection circuitry for comparison of pulse width data and magnitude data to determine if preselected ranges have been exceeded, thereby indicating imminent failure of a capacitor. Detection circuitry may be incorporated in transmission lines, pulse power circuitry, including laser pulse circuitry or any circuitry where capacitors or capacitor banks are utilized.

## 4209 Waste Processing Plants And Equipment

*REFER ALSO TO CITATION(S) 34696, 35277*

## 4210 Combustion Systems

*REFER ALSO TO CITATION(S) 34204, 34244, 34275, 34951, 35090*

**35355 (CONF-8004173—1) Industrial coal-fired fluidized-bed demonstration program. Progress report, April 30-May 1, 1980.** Accortt, J.I.; Comparato, J.R.; Norcross, W.R. (Combustion Engineering, Inc., Windsor, CT (USA)). 1980. Contract AC21-76ET10389. 20p. NTIS, PC A02/MF A01. Order Number DE82000122.

From 19. annual Kentucky industrial coal conference; Lexington, KY, USA (30 Apr 1980).

Progress in the construction, now 35% complete, of an industrial fluidized bed steam generating plant being built at the US Navy Great Lakes Training Facility in Illinois is reported. This plant will provide a practical demonstration of the use of fluidized bed technology in an industrial coal fired application. It has been designed making use of the valuable data and experience gained from the operation and testing of the sub-scale fluidized bed boiler. The construction and shakedown are scheduled to be completed later this year and the formal test program to begin in 1981. The information to be provided from the test series will allow industry to assess the capabilities of fluidized bed combustion under meaningful operation conditions.

**35356 (DOE/ET/15167—191) High-temperature-staged fluidized-bed combustion (HITS), bench scale experimental test program conducted during 1980. Final report.** Anderson, R.E.; Jassowski, D.M.; Newton, R.A.; Rudnicki, M.L. (Aerojet Energy Conversion Co., Sacramento, CA (USA)). Apr 1981. Contract AC21-79ET15167. 204p. NTIS, PC A10/MF A01.

An experimental program was conducted to evaluate the process feasibility of the first stage of the HITS two-stage coal combustion system. Tests were run in a small (12-in. ID) fluidized bed facility at the Energy Engineering Laboratory, Aerojet Energy Conversion Company, Sacramento, California. The first stage reactor was run with low (0.70%) and high (4.06%) sulfur coals with ash fusion temperatures of 2450° and 2220°F, respectively. Limestone was used to scavenge the sulfur. The produced low-Btu gas was burned in a combustor. Bed temperature and inlet gas percent oxygen were varied in the course of testing. Key results are summarized as follows: the process was stable and readily controllable, and generated a free-flowing char product using coals with low (2220°F) and high (2450°F) ash fusion temperatures at bed temperatures of at least 1700° and 1800°F, respectively; the gaseous product was found to have a total heating value of about 120 Btu/SCF at 1350°F, and the practicality of cleaning the hot product gas and delivering it to the combustor was demonstrated; sulfur capture efficiencies above 80% were demonstrated for both low and high sulfur coals with a calcium/sulfur mole ratio of approximately two; gasification rates of about 5,000 SCF/ft$^2$-hr were obtained for coal input rates ranging from 40 to 135 lbm/hr, as required to maintain the desired bed temperatures; and the gaseous product yielded combustion temperatures in excess of 3000°F when burned with preheated (900°F) air. The above test results support the promise of the HITS system to provide a practical means of converting high sulfur coal to a clean gas for industrial applications. Sulfur capture, gas heating value, and gas production rate are all in the range required for an effective system. Planning is underway for additional testing of the system in the 12-in. fluid bed facility, including demonstration of the second stage char burnup reactor.

**35357 (DOE/MC/11284—1100) Reduction of nitric oxide in a fluidized bed. Final report.** Huang, Z.; Chen, G.T.; Wen, C.Y. (West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering). Jul 1981. Contract AM21-79MC11284. 69p. NTIS, PC A04/MF A01. Order Number DE81030488.

Reduction of nitric oxide (NO) by two kinds of char, coke, carbon monoxide, and methane was investigated in a bed (I.D. 9.6 cm) of glass sand (static bed depth, 10 cm) fluidized by nitrogen containing a small amount of nitric oxide. The bed was heated externally by an electric heater and the effect of char loading on NO reduction was studied over a wide range of temperatures. It was found that the reactivities of different chars and coke depend strongly upon their physical properties (such as surface area and porosity), upon the type of char, and to a lesser extent upon their carbon content. The reduction of NO with carbon monoxide was also investigated in the fluidized bed and the result showed that the stainless steel wall exerted a significant catalytic effect on this reaction. In order to obtain information for design and operation of fluidized-bed combustors, kinetic evaluation of the reaction of NO with Char 1 was performed. Based on the two-phase bubble model with both bubble phase and emulsion phase in plug flow, the data were analyzed to formulate the reaction rate expression. The activation energy and frequency factor were 31,700 cal/mol and 9.66 x $10^8$ 1/sec respectively.

**35358 (DOE/PC/30297—T4) Assessment of pulverized-coal-fired combustor performance. Third quarterly technical progress report, April 1, 1981-June 30, 1981.** Richter, W.; Clark, W.; Payne, R. (Energy and Environmental Research Corp., Santa Ana, CA (USA)). Jul 1981. Contract AC22-80PC30297. 28p. NTIS, PC A03/MF A01. Order Number DE81030860.

This program is concerned with the provision of a technology base to expedite the conversion of industrial processes from oil and gas to coal and other pulverized fuels. It addresses primarily the impact of fuel type on the thermal performance of a combustor. The program incorporates two experimental tasks and is constructed around an analytical task (Task 1) which will identify and upgrade a family of computer programs required to undertake thermal performance analysis studies. These analytical tools will thus be used to predict the effects of parameters such as fuel type and furnace variables on combustor performance, and to identify those properties which have a major impact on thermal performance. The second task uses a combustion reactor to screen the key variable identified in Task I and to provide data on the properties of coal particulate matter which affect heat transfer performance. Verification of the engineering analytical approach will be provided by measurements made in a pilot-scale furnace in the third task. Progress is reported.

**35359 (EPRI-AP—1978) Fundamental combustion studies of burning oil-spray flames. Final report.** (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). Aug 1981. 102p. NTIS, PC A06/MF A01. Order Number DE81904248.

This report presents information concerning burning processes in oil-spray flames and provides technical data for the design of low-NO/sub x/ combustors for gas turbines. Three studies are detailed: a bench-scale flame study, a full-size gas turbine combustor operated at atmospheric pressure, and measurements on full-size test-stand combustors operated at higher pressures. A laser velocimeter used to measure hot gas velocities is described, and the initiation of a combustion model study is reviewed.

**35360 (EPRI-CS—2010) Fines recycle modeling for an atmospheric fluidized-bed coal combustor. Final report.** Brimhall, W.L.; Fields, D.E.; Rickman, W.S. (General Atomic Co., San Diego, CA (USA)). Aug 1981. 66p. NTIS, PC A04/MF A01. Order Number DE81904223.

A fine carbon combustion model developed by General Atomic Company (GA) was modified to predict combustion efficiencies as a function of several process variables in the Babcock

and Wilcox (B and W) 6 ft by 6 ft atmospheric fluidized-bed coal combustor. The coal fines combustion kinetics were determined using the model and fines recycle test data from the 6 ft by 6 ft facility. Combining the combustion model and empirically determined coal fines kinetics, the overall combustion efficiency in the 6 ft by 6 ft facility was determined as a function of fines recycle rate, superficial gas velocity, bed depth, freeboard length, and fines reentry temperature. The results of the model indicate that a fines recycle rate of approximately 2.5 times the coal feed rate will be required to achieve a 99% combustion efficiency in the 6 ft by 6 ft facility using the current operating parameters.

### 4220 Underground Engineering

*REFER ALSO TO CITATION(S) 34260*

### 4240 Pollution Control Equipment

*REFER ALSO TO CITATION(S) 34288, 35320*

35361 (CONF-801030—(Vol.1), pp 233-241) **Add-on emission controls for world market light duty vehicles gasoline-alcohol comparisons: Soviet Lada, Brazilian Puma, South Korean Hyundai Beema.** Olson, D.R. (Olson Engineering, Huntington Beach, CA); Zeitlin, A. 1980. NTIS (US Sales Only), PC A21/MF A01. Order Number DE81903753.

From 4. international symposium on alcohol fuels technology; Sao Paulo, Brazil (5 Oct 1980).

Adaptation of current emission control technology and components to vehicles manufactured for world markets can be successfully accomplished for light duty vehicles. The engineering approach to this task and description of emission control systems with gasoline and gasoline-alcohol emission/fuel economy comparison data are provided for the Brazilian Puma, Soviet Lada and South Korean Beema vehicles.

35362 **(DOE/ET/11031—T1) Laminar-flow-cyclone development program. Final technical report, November 1, 1978-May 31, 1981.** Giles, W.B. (General Electric Co., Schenectady, NY (USA)). Jun 1981. Contract AC21-78ET11031. 96p. (FE—3242-33). NTIS, PC A05/MF A01. Order Number DE81001297.

An exploratory investigation was conducted into the feasibility of maintaining laminar flow in a cyclone separator. Various experimental models were used to simulate the essential flow requirements, and observations were conducted on the turbulent-laminar character of the flow. From this, it was concluded that laminar flow could be maintained up to relatively high Reynolds numbers in the radially-inward swirl flow regime. However, a large-scale instability occurs in turning to the axial swirlflow regime. All present attempts to suppress this instability failed, and the investigation was terminated.

## 43 PARTICLE ACCELERATORS

### 4301 Design, Development, And Operation

35363 **(UCID—19187) Simple model of beam transport in low-pressure ion-focused regimes.** Briggs, R.J. (Lawrence Livermore National Lab., CA (USA)). 1 Sep 1981. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01. Order Number DE82000242.

This paper presents a simple model of self-focused beam transport at very low gas pressures, where fractional electric neutralization is incomplete and secondary electrons are expelled from the beam region.

35364 **Laser-driven grating Linac.** Palmer, R.B. (Brookhaven National Lab., Upton, NY (USA)). *Particle Accelerators ;* **11**: No. 2, 81-90(Dec 1980).

The acceleration of particles in the fields above a grating exposed to coherent radiation has been studied showing that such acceleration is possible and that it can occur at a cylindrical or axicon focus over a linear gating. It has further been shown that the accelerating field can be larger than that present in the absence of the grating. The limits which practical considerations might place on the energies that could be obtained with such devices are considered and it is concluded that very high energies (2-20 TeV) might be possible, making the proposed scheme a serious candidate for the next generation of accelerators.

35365 **High power linear pulsed beam annealer.** Strathman, M.D.; Sadana, D.K.; True, R.B. (to Dept. of Energy). US Patent Application 210,488. 26 Nov 1980. 9p.

A high power pulsed electron beam system for annealing semiconductors is comprised of an electron gun having a heated cathode, control grid and focus ring for confining the pulsed beam of electrons to a predetermined area, and a curved drift tube. The drift tube and an annular Faraday shield between the focus ring and the drift tube are maintained at a high positive voltage with respect to the cathode to accelerate electrons passing through the focus ring, thereby eliminating space charge limitations on the emission of electrons from said gun. A coil surrounding the curved drift tube provides a magnetic field which maintains the electron beam focused about the axis of the tube. The magnetic field produced by the coil around the curved tube imparts motion to electrons in a spiral path for shallow penetration of the electrons into a target. It also produces a scalloped profile of the electron beam. A second drift tube spaced a predetermined distance from the curved tube is positioned with its axis aligned with the axis of the first drift tube. The second drift tube and the target holder are maintained at a reference voltage between the cathode voltage and the curved tube voltage to decelerate the electrons. A second coil surrounding the second drift tube, maintains the electron beam focused about the axis of the second drift tube. The magnetic field of the second coil comprises the electron beam to the area of the semiconductor on the target holder.

### 4303 Auxiliaries And Components

*REFER ALSO TO CITATION(S) 35340, 35577, 35643*

35366 **(BNL—29985) Progress and prospects at the national synchrotron light source (NSLS).** Howells, M.R. (Brookhaven National Lab., Upton, NY (USA)). Jul 1981. Contract AC02-76CH00016. 20p. (CONF-810750—6). NTIS, PC A02/MF A01. Order Number DE81030738.

From 2. national conference on synchrotron radiation instrumentation; Ithaca, NY, USA (15 Jul 1981).

This report discusses the NSLS project from inception until the present. The commencement and motivation for the program are considered from the viewpoint of the needs of various experiments and the concepts of the Basic Source is introduced. The Basic Source has high brightness and tunability within the ranges 0 to 0.3 keV and 3 to 20 keV. The inclusion of tunability implies the use of monochromators and the role of these is discussed. The Basic Source is important because it satisfies a very large proportion of users. The strategy of NSLS in providing a good Basic Source and special devices (monochromators and wigglers) to allow coverage of the energy ranges outside those of the Basic Source is described. The response of the NSLS to various other general and special needs of experimental users is described. Turning to the Free Electron Laser Project, a brief description of that device is given followed by a progress report of the overall NSLS construction program. The broad conclusion is that the NSLS facility will be completed within 2 to 3 months of its scheduled timescale and within its budget. This is considered to be a highly successful conclusion to the construction program.

35367 **(CONF-810944—2) ORIC stripping foil positioner for tandem beam injection.** Ludemann, C.A.; Lord, R.S.; Hudson, E.D.; Irwin, F.; Beckers, R.M.; Haynes, D.L.; Casstevens, B.J.; Mosko, S.W. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 3p. NTIS, PC A02/MF A01. Order Number DE81032034.

From 9. international conference on cyclotrons and their applications; Caen, France (7 Sep 1981).

The Oak Ridge Isochronous Cyclotron (ORIC) is used as an energy booster for heavy ions from a 25 MV tandem accelerator.

This operation requires precise placement of a stripping foil in the cyclotron for capture of the injected ions into an acceleration orbit. The mechanical design and control of the foil positioning device are described.

35368 **(CONF-810944—3) Superconducting conversion of the Oak Ridge isochronous cyclotron.** Martin, J.A.; Ball, J.B.; Cleary, T.P. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01. Order Number DE81032030.

From 9. international conference on cyclotrons and their applications; Caen, France (7 Sep 1981).

The superconducting conversion of ORIC is being planned to replace the aluminum main magnet coils with an NbTi superconducting coil system. The average magnetic field would be increased from the present 1.9 T to 3.3 T to provide a maximum increase in energy 100 to 300 $q^2/A^2$.

35369 **(CONF-810944—4) Initial operation of ORIC with tandem injection.** Ludemann, C.A.; Ball, J.B.; Beckers, R.M.; Cleary, T.P.; Hudson, E.D.; Lord, R.S.; Martin, J.A.; Milner, W.T.; Mosko, S.W.; Ziegler, N.F. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01. Order Number DE81032031.

From 9. international conference on cyclotrons and their applications; Caen, France (7 Sep 1981).

Coupled operation of the 25 MV tandem and ORIC was achieved on January 27, 1981. The initial beam was 324 MeV $^{16}O^{8+}$ followed shortly by oxygen at 400 MeV-the maximum design energy. Following additional installation and testing of the tandem, coupled operation for a nuclear physics experiment began in August. Performance of the system was in close agreement with that predicted from calculations.

35370 **(DOE/ER/40014—5) rf field effects on the cyclotron arc source.** Stern, R.A.; Rodenburg, R.E.; Benage, J.F. Jr.; Lind, D.A. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.). 1981. Contract AC02-81ER40014. 3p. (CONF-810944—5). NTIS, PC A02/MF A01. Order Number DE81030972.

From 9. international conference on cyclotrons and their applications; Caen, France (7 Sep 1981).

By exploiting recent developments in plasma physics a program to diagnose changes in source properties during ion beam extraction has been initiated to improve source efficiency. A small cyclotron with a conventional hooded arc provides radiation from excited species (H/sub $\beta$/ and the 4685 A line of HeII) which is spectrally analyzed and detected by a high-frequency photomultiplier. The intensity of the radiation is sensitive to changes in the electron and ion densities, and enables an analysis of the effect of the rf field on the plasma properties of the source. We have evidence that coupling of the rf extraction field to normal modes of the plasma - the Electrostatic Ion Cyclotron waves - occurs, permitting rf field penetration to the entire plasma column and large beam extraction.

35371 **(SLAC-TN—81-7) Two-dimensional beam-profile monitor using the Reticon MC510A array camera.** Gottschalk, B. (Stanford Linear Accelerator Center, CA (USA)). Aug 1981. Contract AC03-76SF00515. 70p. NTIS, PC A04/MF A01. Order Number DE81030853.

A quantitative two-dimensional beam profile may be obtained from a scintillator viewed by a Reticon camera which uses a 32 x 32 array of photodiodes as its sensing element. In this note, CAMAC-oriented data acquisition electronics which allow one either to transmit the profile to a computer, or to use the monitor in a stand-alone mode are described.

35372 **(UCID—19197) ATA injector-gun calculations.** Paul, A.C. (Lawrence Livermore National Lab., CA (USA)). 3 Aug 1981. Contract W-7405-ENG-48. 54p. NTIS, PC A04/MF A01. Order Number DE82001149.

ATA is a pulsed, 50 ns 10 KA, 50 MeV linear induction electron accelerator at LLNL. The ETA could be used as an injector for ATA. However the possibility of building a new injector gun for ATA, raised the question as to what changes from the ETA gun in electrode dimensions or potentials, if any, should be considered. In this report the EBQ code results for the four electrode configurations are reviewed and an attempt is made to determine the geometrical scaling laws appropriate to these ETA type gun geometries. Comparison of these scaling laws will be made to ETA operation. The characteristic operating curves for these geometries will also be presented and the effect of washer position determined. It will be shown that emittance growth will impose a limitation on beam current for a given anode potential before the virtual cathode limit is reached.

35373 **High efficiency ion beam accelerator system.** Aston, G. (Sr. Engineer, Electric Propulsion and Advanced Concepts Group, Jet Propulsion Laboratory, Pasadena, California 91109). *Review of Scientific Instruments ;* **52**: No. 9, 1325-1327(Sep 1981).

An ion accelerator system that successfully combines geometrical and electrostatic focusing principles is described. This accelerator system uses thin, concave, multiple-hole, closely-spaced graphite screen and focusing grids, coupled to single slot accelerator and decelerator grids to provide high ion extraction efficiency with good focusing. Operating characteristics for this type of accelerator system and possible applications are discussed.

35374 **Typical problems of the correction magnets for Fermilab energy saver.** Ciazynski, D.; Mantsch, P. (Fermilab, Batavia, Ill). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-17**: No. 1, 165-167(Jan 1981). (CONF-800980—).

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

The fabrication, tests and improvements of the correction magnets are discussed. Results are presented which were obtained on these magnets, the main characteristics of which are to work in an external magnetic field which is generally higher than their own field and to be able to work with different senses of the current which is rather unusual for pulsed superconducting magnets. 5 refs.

35375 **Superconducting Chicago Cyclotron magnet: an old magnet with a new pair of energy efficient coils.** Leung, E.M.W.; Kephart, R.; Fast, R.W.; Heim, J.R. (Fermilab, Batavia, Ill). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics ;* **MAG-17**: No. 1, 199-202(Jan 1981). (CONF-800980—).

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

A DOE-Fermilab energy conservation project is described in which a pair of superconducting tori 5.25 m in diam. have been constructed to replace the copper coils, built in 1949, of the 170-inch Chicago Cyclotron, now in use at Fermilab as an analysis magnet. The superconducting magnet, with a stored energy of 32.5 MJ, was fabricated in-house at Fermilab. Engineering concepts, design and optimization of the coil, support structure and cryogenic system are described. The major support, a composite column capable of a collapse load of 1.33 x $10^6$N and an expected heat leak of 120 MW are outlined. Practical problems encountered during the construction phase are discussed and test results presented. 6 refs.

35376 **Transverse resistive wall instability of a relativistic electron beam.** Caporaso, G.J.; Barletta, W.A.; Neil, V.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *Particle Accelerators ;* **11**: No. 2, 71-79(Dec 1980).

The transverse stability of a relativistic electron beam propagating in an evacuated, smooth pipe of finite conductivity is examined. Exact and asymptotic solutions are obtained in the limit of continuous external focusing. An exact solution for the transport through a single focusing period with discrete focusing is extended to provide an asymptotic solution for a multiperiod transport system. It is found in both cases that focusing can only reduce the growth rate; it cannot suppress the instability. Applications to pulsed electric power transmission are discussed.

35377 **Rotatable seal assembly.** Logan, C.M.; Garibaldi, J.L. (to Dept. of Energy). US Patent Application 206,233. 12 Nov 1980. 9p.

An assembly is provided for rotatably supporting a rotor on a stator so that vacuum chambers in the rotor and stator remain in

communication while the chambers are sealed from ambient air, which enables the use of a ball bearing or the like to support most of the weight of the rotor. The apparatus includes a seal device mounted on the rotor to rotate therewith, but shiftable in position on the rotor while being sealed to the rotor as by an O-ring. The seal device has a flat face that is biased towards a flat face on the stator, and pressurized air is pumped between the faces to prevent contact between them while spacing them a small distance apart to avoid the inflow of large amounts of air between the faces and into the vacuum chambers.

35378 **Experimental enclosures for synchrotron radiation: Design considerations.** Golde, A. (Stanford Univ., CA (USA). Stanford Synchrotron Radiation Lab.); Warren, G. (Stanford Linear Accelerator Center, CA (USA)). *Nuclear Instruments and Methods ;* **172**: No. 1/2, 375-378(May 1980).

From National conference on synchrotron radiation instrumentation; Gaithersburg, MD (4 - 6 Jun 1979).

The Stanford Synchrotron Radiation Laboratory (SSRL) uses synchrotron radiation from the storage ring SPEAR at SLAC. Synchrotron radiation leaves the storage ring tangentially through primary beam ports, then it is split into secondary beam lines for experimental use. Currently, ten secondary beam lines on three primary beam lines can be operated simultaneously. Since the radiation levels in the beam lines are high, each secondary beam line is equipped with its own beam stoppers and equipment enclosures to provide independent operation. The design of experimental eclosures involves a consideration of the radiation type and intensity expected under different operating conditions of the storage ring. In this paper, the design considerations for the experimental enclosures and beam line safety components are discussed. In general, the synchrotron radiation is low energy and easily shielded. The dominant exposure arises from beam loss during the injection process.

### 4304 Storage Rings

35379 **Optimization of a synchrotron radiation source.** Van Steenbergen, A. (Brookhaven National Lab., Upton, NY (USA). National Synchroton Light Source). *Nuclear Instruments and Methods ;* **177**: No. 1, 53-59(1 Nov 1980).

From Japanese/USA seminar on synchrotron radiation facilities; Honolulu, HI, USA (5 - 9 Nov 1979).

Some aspects of the optimization of an electron storage ring as a synchrotron radiation source will be presented. This will include the choice of magnet ring structure, choice of electron accelerating-system parameters and choice of structure sections for the use of high field wigglers or undulators.

35380 **Phenomenological analysis of current limits in storage rings.** Pellegrini, C. (Brookhaven National Lab., Upton, NY (USA)); Sands, M. (California Univ., Santa Cruz (USA)). *Nuclear Instruments and Methods ;* **177**: No. 1, 61-64(1 Nov 1980).

From Japanese/USA seminar on synchrotron radiation facilities; Honolulu, HI, USA (5 - 9 Nov 1979).

We report the limitations on the current which can be stored in a storage ring. A simple model is used for the impedance of the beam environment. We assume that feedback systems are used to their full capacity to provide beam stability and that in the frequency range where feedback can no longer be used Landau damping will determine how much current can be stored in the ring. Estimates are made for the proton storage rings and for the electron storage rings of interest as synchrotron radiation sources and for colliding beam systems for high energy physics.

## 44 INSTRUMENTATION

### 4401 Radiation Instrumentation

35381 **(LBL—12572) Multiplicity detector using a glow-discharge memory.** Mulera, T.; Elola, M.; Perez-Mendez, V.; Wiedenbeck, P. (Lawrence Berkeley Lab., CA (USA)). Apr 1981. Contract W-7405-ENG-48. 5p. (CONF-811106—1). NTIS, PC A02/MF A01. Order Number DE81025337.

From Institute of Electronics and Electrical Engineers nuclear sciences symposium; San Francisco, CA, USA (21 Nov 1981).

It has been proposed to eliminate the x-y cor relation ambiguities introduced by multiple tracks in a wire chamber by using the chamber itself as a memory. Hits in the chamber itself ignite glow discharges storing the x-y location of the hits in a correlated fashion. Glow ignition may be achieved by employing a multi-step avalanche chamber above a memory gap. Correlation is maintained during readout by successively pulsing each hit wire in one coordinate and sensing transmissions through glows in the other coordinate. Prototypes constructed by the authors are discussed along with the associated high voltage and readout systems.

35382 **Real-time tritium imaging.** Malinowski, M.E. (Sandia National Laboratories, Livermore, California 94550). *Applied Physics Letters ;* **39**: No. 6, 509-511(15 Sep 1981).

A real-time image of a tritium-containing titanium film has been made by detecting the secondary electrons produced by tritium $\beta$ decay with a simple two-element electrostatic lens and microchannel plate image intensifier. The obtained image indicates that a resolution of better than 100 $\mu$m is currently obtainable and suggests that image magnification to enhance resolution should be possible.

### 4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

35383 **(NASA-CR—161687) A survey of space radiation effects.** Hill, C.W. (Science Applications, Inc., Huntsville, AL (USA)). Mar 1980. 31p. NTIS PC A03/MF A01.

The effects of space radiation and its significance for space missions, as they increase in scope, duration, and complexity are discussed. Type of radiation hazard may depend on location or on special equipment used. It is emphasized that it is necessary to search for potential radiation problems in the design stage of a mission. Problem areas such as radiation damage to solar cells and the revolutionary advances are discussed. Radiation effect to electronics components other than solar cells, and several specialized areas such as radioactivity and luminescence are also examined.

### 4403 Miscellaneous Instruments

*REFER ALSO TO CITATION(S) 34205, 34369, 34733, 34767, 34768, 35339, 35489*

35384 **(BNL—29838) Theory of a modified Wadsworth monochromator matched to a low energy storage ring source.** Howells, M.R. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 21p. (CONF-810750—3). NTIS, PC A02/MF A01. Order Number DE81030034.

From 2. national conference on synchrotron radiation instrumentation; Ithaca, NY, USA (15 Jul 1981).

The concave diffraction grating in the Wadsworth mounting has been popular with synchrotron radiation spectroscopists because of its use of parallel light. This is well matched to experimental stations which are a great distance away from the source as would be the case in using a high energy synchrotron. For low energy storage rings the working distance is quite small and in this case it is appropriate to use a collimating mirror. Large collection angles are possible with this arrangement and reasonable resolution can be obtained using spherical surfaces. Astigmatism is much lower than for Rowland circle mountings. These questions are analyzed using an optical path function development and calculations are presented which include the aberrations both in the two optics and those caused by the large extension of the source in the direction of the radiation emission.

35385 **(SAND—81-1309) Mobile Laboratory for intrusion sensor processor development.** Lightstone, P.C.; Davidson, W.M. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1981. Contract AC04-76DP00789. 13p. NTIS, PC A02/MF A01. Order Number DE81030990.

In this report, we describe the Mobile Laboratory and list its on-board equipment. This equipment is intended to help us in de-

veloping systems which will answer the problems of intruder detection. Presently, the equipment fills the needs of Task 12 (MAFTS) and Task 22 (MADP).

35386 **(SAND—81-1503C) Measurement of surface shape of imploding hollow plasma liners.** Hansche, B.D. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 6p. (CONF-811113—12). NTIS, PC A02/MF A01. Order Number DE81030996.

From American Vacuum Society national symposium; Anaheim, CA, USA (3 Nov 1981).

Imploding hollow plasma liners are quite thin, and therefore fragile, membranes. They tend to have imperfections such as wrinkles, and measurement of the size and shape of these imperfections is important both for prediction of the performance of a particular liner, and for quantitatively studying the fabrication process, in an attempt to minimize the imperfections. Here we describe an optical technique which maps the surface shape of some of these liners.

35387 **(SAND—81-1598) Laser systems for the Combustion Research Facility - Orion.** Brannon, P.J.; Franklin, F.R.; Jones, E.D. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1981. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01. Order Number DE81030989.

A frequency doubled Nd:YAG/Glass laser system has been constructed for use at the Combustion Research Facility at Sandia National Laboratories, Livermore. This laser system will be used to make single shot spontaneous Raman Spectroscopy measurements of ongoing combustion processes. The output of the system is 5 J of 1.064 μm radiation and 0.8 J or 532 nm radiation in a 2 μsec pulse. The repetition rate of the system is 1 pps. A microprocessor-based diagnostic and control system for the operation is described.

35388 **(UCRL—86333) Calculations of elastic wave scattering from voids and crack-like defects by the method of optimal truncation.** Opsal, J.L. (Lawrence Livermore National Lab., CA (USA)). 29 Jun 1981. Contract W-7405-ENG-48. 7p. (CONF-800767—4). NTIS, PC A02/MF A01. Order Number DE81030770.

From DARPA/AFML review of progress in quantitative NDE conference; La Jolla, CA, USA (14 Jul 1980).

Visscher's method of optimal truncation for solving elastic wave scattering problems has been applied to voids having surface cracks and sharp edges including some for which experimental data are becoming available. A number of interesting aspects of these results are discussed and comparisons with existing experimental data presented.

35389 **Hyper-filter—fluorescer spectrometer for x rays above 120 keV.** Wang, C.L. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). W-7405-ENG-48. *Review of Scientific Instruments ;* **52**: No. 9, 1317-1320(Sep 1981).

We present a new method of utilizing a filter—fluorescer system for measuring high fluence x-rays above 120 keV, where there are no practical absorption edges available for conventional filter—fluorescer techniques. The absorption edge (E/sub p/ keV) of the prefilter is chosen to be less than that of the fluorescer (E/sub f/ keV), i.e., E/sub p/ < E/sub f/, contrary to the conventional technique, E/sub p/ > E/sub f/. In this way the response function is rendered virtually zero between E/sub p/ and E/sub f/, while a broad peak at higher energy is enhanced for measurement above 120 keV. An application of the method for x-ray measurement between 150 and 350 keV from laser-driven nuclear fusion is described.

35390 **Apparatus to study the electron spin resonance of fluids under high pressure flowing at high temperature.** Livingston, R.; Zeldes, H. (Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Review of Scientific Instruments ;* **52**: No. 9, 1352-1357(Sep 1981).

An electron spin resonance (ESR) system is described in which a fluid sample is pressurized and flowed through a fused silica capillary that traverses the microwave cavity of an ESR spectrometer. The capillary is heated to a high temperature, and well-resolved spectra of short-lived free radicals may be seen at steady-state concentration during pyrolysis. The system operates to 20.7 MPa and 700 °C. High-pressure hydrogen may be injected prior to pyrolysis. A spectrum of benzyl during pyrolysis of toluene at 20.7 MPa and 680 °C is shown.

35391 **Refractive index change and curvature in shock waves by angled beam refraction.** Kiefer, J.H.; Manson, A.C. (Department of Energy Engineering, University of Illinois at Chicago Circle, Chicago, Illinois 60680). ER-78-S-502-4759. *Review of Scientific Instruments ;* **52**: No. 9, 1392-1396(Sep 1981).

Observations of front geometry and refractive index jump across shock waves in rare gases have been made with a new and particularly simple technique. The technique involves determination of the angular deflection of a narrow laser beam intersecting the shock front at a shallow angle. Measured refractive index jumps in rare gases are in excellent agreement with those calculated using Snell's law and ideal shock theory. The apparent shock curvature is in close accord with deBoer's theory for loading pressures below 20 Torr, but above this presure there is evidence of an indentation near tube center.

35392 **Applications of the optical multichannel analyzer for low light level signal averaging and two-dimensional mode detection of picosecond laser-generated Raman spectra.** Chao, J.L. (Department of Chemistry and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). W-7405-ENG-48. *Applied Spectroscopy ;* **35**: No. 3, 281-289(May 1981).

Techniques developed for the use of a programmable optical multichannel analyzer are discussed. Two different signal-limited areas which are of general spectroscopic interest are the focus of the paper. The first area involves using extended delay target intergration techniques for low level light signal averaging. The second application area describes techniques developed for capturing spectral information from pulsed laser experiments. Multiple tacks are shown in order to demonstrate the two-dimensional applications in spectroscopy. The paper also contains information about the design and operating principles of vidicon detectors and other imaging technologies are considered as well.

# 45 EXPLOSIONS AND EXPLOSIVES

## 4501 Chemical

35393 **(LA—8920) Prediction of crystal densities of organic explosives by group additivity.** Stine, J.R. (Los Alamos National Lab., NM (USA)). Aug 1981. Contract W-7405-ENG-36. 28p. NTIS, PC A03/MF A01. Order Number DE81032016.

The molar volume of crystalline organic compound is assumed to be a linear combination of its constituent volumes. Compounds consisting only of the elements hydrogen, carbon, nitrogen, oxygen, and fluorine are considered. The constituent volumes are taken to be the volumes of atoms in particular bonding environments and are evaluated from a large set of crystallographic data. The predicted density has an expected error of about 3%. These results are applied to a large number of explosives compounds.

35394 **(MHSMP—81-39) Skid-test evaluation of protective coverings for explosive billets.** Crutchmer, J.A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Sep 1981. Contract AC04-76DP00487. 8p. NTIS, PC A02/MF A01. Order Number DE82000072.

A total of thirteen materials were evaluated for use as protective coverings for as-pressed explosive billets. A small sample of material was taped over the contact area of the skid billets during testing. Preliminary skid testing indicated several of these materials may be effective as protective coverings. Three of the materials were selected, based on their strength and ease of handling, for complete skid test evaluation using as-pressed PBX 9404. Nylon mesh, style 8664 was found to give the greatest protection against accidental detonation of the explosive.

35395 **(MHSMP—81-40) Evaluation of cleaning procedures and bonding materials for TPX plastic.** Flowers, G.L.; Montague, J.L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Sep 1981. Contract AC04-76DP00487. 9p. NTIS, PC A02/MF A01. Order Number DE82000048.

TPX plastic parts currently undergo a chromium trioxide acid etch and polyolefin primer application prior to being bonded to LX-17 explosive parts with Exlostik 473. This study evaluates Explostik 473 (epoxy), APC 2.5 (Silicone) and Hexcel Uralite 3121 S (urethane) adhesives and several surface treatments. These surface treatments include acid etch; acid etch and polyolefin primer; polyolefin primer; oxygen plasma clean; oxygen plasma clean and polyolefin primer. Results indicate that oxygen plasma cleaning is the best surface treatment. Plasma treatment times as short as 2.5 min do an adequate job. Plasma-treated parts remain clean and bondable for at least 16 days after treatment.

35396 **(MLM—2860-OP) Surface studies of plastic-bonded PETN and RDX by X-Ray Photoelectron Spectroscopy (XPS) and Ion-Scattering Spectroscopy (ISS).** Wang, P.S.; Moddeman, W.E.; Haws, L.D.; Wittberg, T.N.; Peters, J.A. (Mound Facility, Miamisburg, OH (USA); Dayton Univ., OH (USA). Research Inst.). 1981. Contract AC04-76DP00053. 25p. (CONF-810926—5). NTIS, PC A02/MF A01. Order Number DE81030402.

From 11. symposium on explosives and pyrotechniques; Philadelphia, PA, USA (15 Sep 1981).

Surface structures of plastic bonded PETN and RDX were studied by high resolution X-Ray Photoelectron Spectroscopy (XPS) and Ion Scattering Spectroscopy (ISS). The coating material is a copolymer of vinyl chloride and chlorotrifluoroethylene. Specimens with 6 wt % of the coating on RDX and 4 wt % on PETN were used in these studies. High resolution elemented XPS spectra of F 1s, N 1s, C 1s, and Cl 2p indicate that the surface of coated RDX (PBX-9407) is covered and the coating film is thicker than 100A; the results with coated PETN (LX-16) show the surface layer to be thinner than 100A. $^3He^+$ ISS data on LX-16 suggest that the coating on PETN is not uniform and is, in fact, absent in some regions.

35397 **(UCRL—52000-81-9) Energy and technology review.** (Lawrence Livermore National Lab., CA (USA)). Sep 1981. Contract W-7405-ENG-48. 40p. NTIS, PC A03/MF A01. Order Number DE82000304.

Articles are presented on optical fibers used in nuclear test diagnostics, understanding the physics of explosion products, and arms control in the eighties. (GHT)

### 4502 Nuclear

*REFER ALSO TO CITATION(S) 35397, 35397*

## 50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

*REFER ALSO TO CITATION(S) 35522*

### 5001 Basic Studies

*REFER ALSO TO CITATION(S) 35422*

35398 **(LA-UR—81-1932) Comparison of a drainage flow model with the data of Manins & Sawford.** Davis, C.G.; Freeman, B.E. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 3p. (CONF-811104—5). NTIS, PC A02/MF A01. Order Number DE81025366.

From AMS conference on mountain meterology; Steamboat Springs, CO, USA (10 Nov 1981).

SIGMET is a system of computer codes developed to simulate mesoscale meteorology in regions containing complex terrain. This study attempts to quantify the effects of temperature differences along valley slopes, vegetation, humidity, and large scale geostrophic winds. (ACR)

35399 **(LA-UR—81-2121) Study of the nocturnal drainage flow over a sloping plateau in north-central New Mexico.** Bowen, B.M.; Dewart, J.M.; Fernald, F.G. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 9p. (CONF-811104—6). NTIS, PC A02/MF A01. Order Number DE81028744.

From AMS conference on mountain meterology; Steamboat Springs, CO, USA (10 Nov 1981).

This paper analyzes the drainage winds at Los Alamos. In addition, other local winds at Los Alamos are discussed: (1) upslope wind, (2) mountain-valley wind, (3) downslope flow due to terrain-forced thunderstorms, and (4) strong nighttime winds due to inversion decoupling.

35400 **(RHO-BWI-C—98) Pasco Basin hydrometeorological study.** Gutknecht, P.J.; Rice, W.A.; Cole, C.R.; Freshley, M.D. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group; Pacific Northwest Lab., Richland, WA (USA)). Apr 1980. Contract AC06-77RL01030. 258p. (PNL—3855). NTIS, PC A12/MF A01. Order Number DE82000283.

This report provides detailed precipitation and evapotranspiration distributions for the Pasco Basin for use in groundwater recharge calculations. The results are shown on precipitation and evapotranspiration distribution maps. The parameters, calculation methods, sensitivity determinations, and fitting methods used in the development of these maps are also discussed.

35401 **(UCRL—85525-Rev.1) Implication of spatial averaging in complex terrain wind studies.** Porch, W.M. (Lawrence Livermore National Lab., CA (USA)). 19 Jun 1981. Contract W-7405-ENG-48. 8p. (CONF-811104—1(Rev.1)). NTIS, PC A02/MF A01. Order Number DE81024451.

From AMS conference on mountain meterology; Steamboat Springs, CO, USA (10 Nov 1981).

Studies of wind over complex terrain have been conducted at two different times at the Geyser's Geothermal Region of Northern California. These studies have included optical anemometers with spatial averaging (Lawrence et al., 1972) over path lengths of 0.6 to 1 km and conventional cup-vane anemometers. Most of the work described in this paper resulted from field studies conducted as a part of ASCOT (Dickerson and Gudiksen, 1980) experiments in July, 1979 and September, 1980. It represents an effort to use measurements of spatially averaged wind to obtain the average drainaged wind speed component down a small slopping valley with few locations with reasonable instrument exposure accessible to cup anemometers. By comparing the point and spatially averaged wind measurements, it was hoped that data periods could be chosen for numerical wind field model testing when the two measurements were similar.

35402 **(UCRL—85569) Categorization of nocturnal drainage flows in the Anderson Creek valley.** Gudiksen, P.H.; Walton, J.J. (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 5p. (CONF-811104—2). NTIS, PC A02/MF A01. Order Number DE81024374.

From AMS conference on mountain meterology; Steamboat Springs, CO, USA (10 Nov 1981).

A network of eight meteorological towers was operated over about a one-year period within the Anderson Creek valley in the Geysers Geothermal Area of northern California. The purpose was to define the noctural wind and temperature structure along the valley's sloped surfaces for use in evaluating the frequency of drainage flows throughout the year and to assess the representativeness of the flows observed during the few nights that intensive studies were undertaken. (ACR)

35403 **(UCRL—86602) Decomposition of radiational effects of model feedbacks.** Ellsaesser, H.W.; MacCracken, M.C.; Potter, G.L.; Mitchell, C.S. (Lawrence Livermore National Lab., CA (USA)). Aug 1981. Contract W-7405-ENG-48. 9p. (CONF-810396—1). NTIS, PC A02/MF A01. Order Number DE81030302.

From Workshop on responsible interpretation of atmospheric models and related data; La Jolla, CA, USA (9 Mar 1981).

Three separate doubled $CO_2$ experiments with the statistical dynamic model are used to illustrate efforts to study the climate dynamics, feedbacks, and interrelationships of meteorological parameters by decomposing and isolating their individual effects on radiation transport.

## 5002 Chemicals Monitoring And Transport

*REFER ALSO TO CITATION(S) 34238, 34240, 34241, 34294, 34295, 34435, 35020, 35160, 35163, 35167, 35361, 35504, 35505, 35506, 35516*

35404 (ANL—80-115-Pt.3, pp 33-36) **Note on the use of box models for estimating dry deposition velocity.** Williams, R.M. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

Recent papers have made use of so-called box models for estimating the dry deposition velocity (or inversely the residence time) of atmospheric contaminants over the Great Lakes. This note shows these models should be applied with caution to the short-fetch conditions existing over the Great Lakes because of the large inherent uncertainties involved.

35405 (ANL—80-115-Pt.3, pp 37-38) **Model for the dry deposition of particles on natural water surfaces.** Williams, R.M. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

From Environmentrics 81; Alexandria, VA, USA (8 Apr 1980).

Atmospheric dry deposition is an important factor in the process by which particulate matter and associated pollutants are introduced into natural water surfaces. The rate of deposition of particles is of special concern in the evaluation of mass budgets and subsequent prediction of water concentration trends. This paper presents a model of particulate dry deposition which delineates the relative significance of the parameters controlling the deposition rate (commonly expressed as deposition velocity). The ultimate goal of this work is to determine a reasonable formulation for the deposition velocity in terms of fairly easily determined parameters, which can be used in detailed mass budget models and in pollutant flux monitoring networks.

35406 (ANL—80-115-Pt.3, pp 39-45) **Air quality changes over southern Lake Michigan: 1973-1974 compared with 1978-1979.** Tisue, G.T.; Fingleton, D.J.; Robbins, J.A.; Allison, R.; Barr, S. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

Air samples taken at Chicago's 68th Street water intake structure corresponding to three sectors of wind direction were analyzed for particulate chemical composition and changes over a five year span compared. Results are given for sulfur, zinc and lead. (ACR)

35407 (ANL—80-115-Pt.3, pp 46-49) **Results of lab and field tests of an organics air sampler.** Wingender, R.J. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

In conjunction with the inorganic air sampling program conducted over Lakes Michigan and Huron, the commitment was made for the sampling of airborne organic pollutants. The inorganics sampler was at first modified to accommodate XAD-2 resin as an adsorbant for organics in the vapor state. As a result of the efforts to optimize the sampling and analytical procedures, a different sampler utilizing Florisil as an adsorbant was designed.

35408 (ANL—80-115-Pt.3, pp 74-79) **Measurement of the spatial and temporal distributions of chlorophyll and total suspended solids in southern Lake Michigan by fluorometry and nephelometry, respectively.** Parker, J.I.; Kennedy, C.W.; Stanlaw, K.A. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

Modeling the fate and potential effects of toxic contaminants in the Great Lakes is dependent on the knowledge of the spatial and seasonal distributions of plankton and total suspended solids (TSS). Acquisition of the large quantity of data needed to illustrate these trends effectively is constrained by time consuming sample collection and analysis. An automated approach to measuring phytoplankton chlorophyll by in situ continuous-flow fluorometry was described by Lorenzen. Likewise, an automated approach to measuring TSS by in situ continuous-flow nephelometry was described by Stephens and APHA. We have developed shipboard capability in these two techniques, and tested them simultaneously in Lake Michigan for the past two years; and we have documented some seasonal and spatial trends of phytoplankton chlorophyll and TSS in southern Lake Michigan.

35409 **(BNL—29924) Modifications of trajectory models needed for pollutant source-receptor analysis.** Michael, P.; Raynor, G.S. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 10p. (CONF-810841—3). NTIS, PC A02/MF A01. Order Number DE81029915.

From 12. NATO/CCMS international technical meeting on air pollution modeling and its applications; Menlo Park, CA, USA (25 Aug 1981).

The purpose of this note is to discuss some of the difficulties one should expect to encounter when using the usual trajectory models to calculate source-receptor relationships for the incorporation of pollutants into precipitation. Section II discusses sources of difficulty; Section III gives the results of trajectory calculations that were performed to test the sensitivity of source-receptor relationships to transport layer assumptions; Section IV presents some suggestions for future developments.

35410 (CONF-801259—, pp 23-38) **Monitoring indoor air quality.** 1980. NTIS, PC A15/MF A01. Order Number DE81026488.

From Workshop on indoor air quality research needs; Leesburg, VA, USA (3 Dec 1980).

Introductions and discussions of measuring methods and research needs on the subject of indoor air pollution are studied. The monitoring section organization consists of aerosols, organics, criteria gases, radon, formaldehyde, and a section on statistics and modelling methods. (DLS)

35411 (CONF-801259—, pp 39-96) **Report of the instrumentation subgroup of indoor air quality.** 1980. NTIS, PC A15/MF A01. Order Number DE81026488.

From Workshop on indoor air quality research needs; Leesburg, VA, USA (3 Dec 1980).

Seven sections describe an initial attempt to formulate a research strategy plan to begin the development of a comprehensive program for developing sampling and analytical methods for hazardous chemical and physical agents which people are exposed to in enclosed structures like residences, offices, and public buildings. The plan calls for the development of instrument requirements, quality assurance programs for analytical laboratories, new and intelligent portable instruments, and Government regulations or guidelines so that instrument manufacturers recognize a market.

35412 **(CONF-810963—1) Atmospheric deposition of heavy metals and their interaction with acid precipitation in a North American deciduous forest.** Lindberg, S.E.; Turner, R.R.; Shriner, D.S.; Huff, D.D. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01. Order Number DE81032004.

From International conference on heavy metals in the environment; Amsterdam, Netherlands (Sep 1981).

Atmospheric deposition dominates the landscape cycle of Pb and has a measurable influence on the cycles of Cd and Zn, but a minimal influence on the Mn cycle in a deciduous forest in the eastern United States. Rain event deposition rates are orders of magnitude greater than the intervening dry deposition rates; however, dry deposition supplies 20 to 90% of the total annual input to the forest. Interactions between dry deposition and acid precipitation result in concentrations of metals and $H^+$ in the canopy 100 to 1000 times higher than rain concentrations alone.

35413 **(EPRI-EA—279-SR) Conclusions and recommendations for EPRI's program in supplementary environmental control systems.** (TRC - The Research Corp. of New England, Wethersfield, CT (USA)). Jun 1976. 23p. (CONF-7606197—1). NTIS, PC A02/MF A01. Order Number DE82900079.

From Supplementary environmental control systems workshop; Hartford, CT, USA (10 Jun 1976).

Two important facts set the stage for the discussions of supplementary environmental control systems (SECS) at the EPRI Workshop on this topic: time-variable emissions control systems, which define SECS broadly, have been used successfully for at least forty years; and present concern over the lack of clearly defined threshold values for air pollutant effects, and the emergence of secondary pollutants as the potentially more dangerous culprits in environmental health, have led to strong opposition to SECS on the part of governmental, regulatory, and environmentally-oriented people. Since the successful use of SECS is based on meeting the national air quality standards, the second points above directly challenge any mode of pollutant control other than continuous control with best available technology. The Workshop quite literally had no choice but to accept the judgments of judicial, legislative, and regulatory agencies that risks associated with environmental pollutants are to be minimized and often without reference to costs. It was concluded that SECS is an acceptable interim measure for air pollution control under specific circumstances only, and will be phased out for the most part by legislative and regulatory fiat. SECS may have some continuing usefulness as a supplement to emission control systems, such as episode control or to satisfy more stringent state and local standards, but these will be special cases and not a general practice. The time is right and the need is great for a detailed analysis of the costs of air pollution emissions control for representative utility networks or power pools using a variety of control options, including SECS. Recommendation of the Workshop are discussed.

35414 **(EPRI-EA—420-Vol.2) Airborne monitoring of cooling-tower effluents. Volume II. Tabulated data. Final report.** Woffinden, G.J.; Harrison, P.R.; Anderson, J.A. (Maryland Dept. of Natural Resources, Annapolis (USA); Meteorology Research, Inc., Altadena, CA (USA)). Jun 1977. 527p. NTIS, PC A23/MF A01. Order Number DE82900034.

This report is Volume 2 of a four volume report set describing aircraft measurements of the Chalk Point Cooling Tower plume. The four volumes include: Vol. 1 - technical summary; Vol. 2 - tabulated data; Vol. 3 - air quality data plots; and Vol. 4 - droplets size data plots. Data included in this volume are from the June 1976 intensive test period. Experimental data are presented in two forms, tables and graphs. The tables (Volume 2) provide exact data as recorded or calculated; these data are to be used in modeling analyses. The graphical plots (Volumes 3 and 4) provide qualitative visualization of the measurement as the sampling aircraft passes through the plume. They also indicate relative instrument delays and correlations between different measurements. Data reported in the data volumes represent only the time during actual plume penetration even though data were also recorded continuously between penetrations. This selective presentation is necessary in order to limit the data volumes to manageable sizes. Additional details of the experimental methods and data handling procedures are given in the technical summary (Volume 1).

35415 **(EPRI-EA—420-Vol.3) Airborne monitoring of cooling-tower effluents. Volume III. Air quality data plots. Final report.** Woffinden, G.J.; Harrison, P.R.; Anderson, J.A. (Maryland Dept. of Natural Resources, Annapolis (USA). Power Plant Siting Program; Meteorology Research, Inc., Altadena, CA (USA)). Jun 1977. 543p. NTIS, PC A23/MF A01. Order Number DE82900032.

This report is Volume 3 of a four volume report set describing aircraft measurements of the Chalk Point Cooling Tower plume. Data included in this volume are from the June 1976 intensive test period. Experimental data are presented in two forms, tables and graphs. The tables (Volume 2) provide exact data as recorded or calculated; these data are to be used in modeling analyses. The graphical plots (Volumes 3 and 4) provide qualitative visualization of the measurement as the sampling aircraft passes through the plume. They also indicate relative instrument delays and correlations between different measurements. Data reported in the data volumes represent only the time during actual plume penetration even though data were also recorded continuously between penetrations. This selective presentation is necessary in order to limit the data volumes to manageable sizes.

35416 **(EPRI-EA—420-Vol.4) Airborne monitoring of cooling-tower effluents. Volume IV. Droplet size data plots. Final report.** Woffinden, G.J.; Harrison, P.R.; Anderson, J.A. (Maryland Dept. of Natural Resources, Annapolis (USA). Power Plant Siting Program; Meteorology Research, Inc., Altadena, CA (USA)). Jun 1977. 481p. NTIS, PC A21/MF A01. Order Number DE82900033.

This report is Volume 4 of a four volume report set describing aircraft measurements of the Chalk Point Cooling Tower plume. Data included in this volume are from the June 1976 intensive test period. Experimental data are presented in two forms, tables and graphs. The tables (Volume 2) provide exact data as recorded or calculated; these data are to be used in modeling analyses. The graphical plots (Volumes 3 and 4) provide qualitative visualization of the measurement as the sampling aircraft passes through the plume. They also indicate relative instrument delays and correlations between different measurements. Data reported in the data volumes represent only the time during actual plume penetration even though data were also recorded continuously between penetrations. This selective presentation is necessary in order to limit the data volumes to manageable sizes.

35417 **(EPRI-EA—1910-Vol.1) Aircraft data summaries for the SURE intensives. Final report.** Blumenthal, D.L.; Tommerdahl, J.B.; McDonald, J.A.; Strong, R.B. (Meteorology Research, Inc., Santa Rosa, CA (USA); Research Triangle Inst., Research Triangle Park, NC (USA)). Sep 1981. 160p. NTIS, PC A08/MF A01. Order Number DE82900314.

As part of the EPRI sulfate regional experiment (SURE), Meteorology Research, Inc., (MRI) and Research Triangle Institute (RTI) conducted six air quality sampling programs in the eastern United States using instrumented aircraft. This volume includes the air quality and meteorological data obtained during the August 1977 Intensive when MRI sampled near the Rockport, Indiana, SURE Station and RTI sampled near the Duncan Falls, Ohio, SURE Station. Sampling data are presented for all measured parameters.

35418 **(EPRI-EA—1910(Vol.4)) Aircraft data summaries for the SURE intensives. Final report.** Keifer, W.S.; Blumenthal, D.L.; Tommerdahl, J.B.; Anderson, J.A.; McDonald, J.A.; Strong, R.B.; White, J.H. (Meteorology Research, Inc., Santa Rosa, CA (USA); Research Triangle Inst., Research Triangle Park, NC (USA)). Sep 1981. 190p. NTIS, PC A09/MF A01. Order Number DE82900311.

As part of the EPRI sulfate regional experient (SURE), six air quality sampling programs were conducted in the eastern United States using instrumented aircraft. This volume includes the air quality and meteorological data obtained during the April 1978 Intensive when samples were taken near the Duncan Falls, Ohio, SURE Station and near the Research Triangle Park, North Carolina, SURE Station. Sampling data are presented for all measured parameters.

35419 **(EPRI-EA—1910-Vol.5) Aircraft data summaries for the SURE intensives. Final report.** Keifer, W.S.; Blumenthal, D.L.; Tommerdahl, J.B.; McDonald, J.A.; Strong, R.B.; White, R.H. (Meteorology Research, Inc., Santa Rosa, CA (USA); Research Triangle Inst., Research Triangle Park, NC (USA)). Sep 1981. 275p. NTIS, PC A12/MF A01. Order Number DE82900310.

As part of the EPRI sulfate regional experiment (SURE), Meteorology Research, Inc., (MRI) and Research Triangle Institute (RTI) conducted six air quality sampling programs in the eastern United States using instrumented aircraft. This volume includes the air quality and meteorological data obtained during the July 1978 Intensive when MRI sampled near the Duncan Falls, Ohio, SURE

Station and RTI sampled near the Scranton, Pennsylvania, SURE Station. During the last part of the July 1978 sampling period, both MRI and RTI aircraft participated in a large regional-scale sampling program with Brookhaven National Laboratory (BNL) and Pacific Northwest Laboratory (PNL). Only the data obtained by the MRI and RTI aircraft during this regional-scale sapling program are included in this volume.

35420 **(EPRI-EA—1911) Tables of statistical summaries for the SURE aircraft measurements. Final report.** Blumenthal, D.L.; Keifer, W.S.; McDonald, J.A. (Meteorology Research, Inc., Santa Rosa, CA (USA)). Sep 1981. 213p. NTIS, PC A10/MF A01. Order Number DE82900317.

During the Sulfate Regional Experiment (SURE), two aircraft simultaneously measured the vertical distribution of air pollutants and meteorological parameters for a total of six two-week periods in the vicinity of various SURE air monitoring stations in the North East US. During all periods, the aircraft were based at least 200 km apart. In general, flights consisted of a set of three spirals between the surface (or minimum legal flight altitude) and 3000 m (10,000 ft) msl. One spiral was made 25 to 80 km upwind of the SURE station, one over the station, and one 25 to 80 km downwind of the station. In general, during each study period, each aircraft made one flight at night and another in midday, every other day for a total of six days. This volume contains a set of statistics for continuously recorded parameters for each flight. For each vertical spiral, statistics have been calculated separately for those data above and below 1500 m msl. For each pollutant parameter and spiral segment, the Mean Value (anti x), the Standard Deviation (S), and the coefficient of Variation (S/anti x) have been calculated. Summary statistics covering all spirals in a flight are also provided.

35421 **(EPRI-EC—125-Vol.3) Design of the sulfate regional experiment (SURE). Volume III. Appendices.** (Environmental Research and Technology, Inc., Westlake Village, CA (USA). Western Technical Center). Feb 1976. 214p. NTIS, PC A10/MF A01. Order Number DE82900123.

This is the third in the four-volume series of reports, which give results of a planning study for the research program on the regional transport, conversion, and fate of air pollutants, the Sulfate Regional Experiment (SURE). This report is made up of four appendices entitled: description and evaluation of laboratory analytical procedures; archive of aerometric data; inventory of sulfur dioxide emissions; sulfate measurement technology; user's manual to the air trajectory box model. A list of the extensive tables is included. (JGB)

35422 **(EPRI-EC—125-Vol.4) Design of the sulfate regional experiment (SURE). Volume IV. Executive summary.** Hidy, G.M.; Tong, E.Y.; Mueller, P.K.; Rao, S.; Thomson, I.; Berlandi, F.; Muldoon, D.; McNaughton, D.; Majahad, A. (Environmental Research and Technology, Inc., Westlake Village, CA (USA). Western Technical Center). Feb 1976. 15p. NTIS, PC A02/MF A01. Order Number DE82900124.

The purpose of the Sulfate Regional Experiment (SURE) is to develop an understanding of the relationships between sulfur oxide emissions and ambient air quality. In this context, air quality is measured in terms of the concentrations of sulfur dioxide and the water soluble sulfates suspended in the ambient air. This report presents the data and reviews the analytical procedures which support design of the SURE. The design itself is Volume 2 of this report.

35423 **(LA—8876-MS) Prototype particle stack sampler with virtual impactor nozzle and microcomputer calculating/display system.** Elder, J.C.; Littlefield, L.G.; Tillery, M.I.; Ettinger, H.J. (Los Alamos National Lab., NM (USA)). Jul 1981. Contract W-7405-ENG-36. 93p. NTIS, PC A05/MF A01. Order Number DE81032018.

A prototype particle stack sampler (PPSS) was developed to improve on the existing Environmental Protection Agency (EPA) Method 5 sampling apparatus. Primary features of the stack sampler were: higher sampling rate; display (on demand) of all required variables and calculated values by a microcomputer-based calculating and display system; continuous stack gas moisture determination; a virtual impactor nozzle designed to separate fine and coarse particle fractions; a variable-area inlet to maintain isokinetic sampling conditions; and stainless-steel components rather than the glass specified by EPA Method 5. The calculating and display system incorporates a single component microcomputer, a single-chip 16-channel analog-to-digital converter, a programmable keyboard/display interface, and liquid crystal displays. The scientific calculations capability and associated display have been incorporated to perform and display the results of 24 equations. These results allow the operator to maintain isokinetic sampler probe temperatures, to maintain proper flow through the sampler probe, and to make sampler probe position changes when necessary. The basic sampling technique of particle collection on preweighed filters was retained; however, versatility in the form of optional in-stack filters and general modernization of the stack sampler have been provided in the prototype design. Laboratory testing with monodisperse dye aerosols has shown the present variable-inlet, virtual impactor nozzle to have significant wall losses and a collection efficiency that is less than 77%. This is primarily due to lack of symmetry in this rectangular jet impactor and short transition lengths dictated by physical design constraints [required by passage of the nozzle through a 7.6-cm (3-in.) diameter stack port]. Electronic components have shown acceptable service in laboratory testing.

35424 **(LA-UR—81-2087) Nocturnal drainage flow over complex terrain using a generalized shallow-fluid approximation.** Freeman, B.E.; Bunker, S.S.; Davis, C.G. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 5p. (CONF-811104—7). NTIS, PC A02/MF A01. Order Number DE81028693.

From AMS conference on mountain meterology; Steamboat Springs, CO, USA (10 Nov 1981).

An approximate formulation of the problem of nocturnal drainage flow has been incorporated into a computer code. This formulation, representing a generalization of the shallow fluid approximation, is applicable to complex terrain and accounts for many of the salient physical effects exhibited by drainage flow. These include the dynamics of the katabatic flow, radiation cooling, surface drag, entrainment of the overlying layer, the Coriolis force and interaction with the synoptic flow. Example calculations have been performed in one and two horizontal dimensions. These calculations exhibit a number of interesting qualitative flow features which have been observed, such as thinning of the layer over ridges and pooling in valleys. We also find that hydraulic jumps are present in the flow. The calculation shows qualitatively correct behavior at modest computational cost. Several processes which are represented parametrically can probably be tuned by comparison with data. Also, by virtue of the low cost of calculations, the model can be applied widely with a resulting gain in experience in how to best use the output. Having cited these advantages, however, it must be recognized that the model is markedly limited by its lack of vertical resolution. The more detailed description afforded by the truly three-dimensional model is necessary for a more complete understanding of this vertical structure.

35425 (LBL—11983, pp 3.27-3.29) **Kinetic studies of reactions involved in the interaction between $SO_2$ and NO/sub x/ in aqueous solutions.** Chang, S.G.; Oblath, S.; Gomiseck, S.; Clem, R.; Novakov, T. Mar 1981. NTIS, PC A03/MF A01. Order Number DE81030532.

In Chemical process research and development program, FY 1980.

Many concurrent and consecutive reactions can take place as a result of interaction between $SO_2$ and NO/sub x/ in aqueous solutions. Although the kinetics of many of these reactions have been studied, the results of previous work by other scientists showed conflicting conclusions on some reactions, while the kinetics of some other reactions have not been well characterized yet. We have investigated the kinetics of reactions between nitrite and bisulfite, and hydroxylamine and bisulfite as part of an effort to acquire a fundamental understanding of the chemical interaction between $SO_2$ and NO/sub x/ in aqueous solutions and to develop and investigate the potential of chemical additives for lime/limestone flue gas desulfurization (FGD) scrubbers to upgrade performance in environmental control of $SO_2$ and NO/sub x/.

35426 **(LBL—12886) Indoor air pollution from domestic combustion appliances.** Traynor, G.W.; Apte, M.G.; Girman, J.R.; Hollowell, C.D. (Lawrence Berkeley Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 14p. (CONF-810909—5). NTIS, PC A02/MF A01. Order Number DE81030529.

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

Indoor air pollution from domestic combustion appliances poses a potential health risk to occupants. We have measured pollutant levels from the oven and top burners of a gas-fired stove and from a portable kerosene-fired space heater (convective type) contained in an environmental chamber. Results showed that indoor pollutant levels from both appliances were far in excess of outdoor levels. We also developed a mathematical model for calculating emission rates per calorific value of fuel consumed and applied this model to our laboratory studies. Comparison of measured and calculated data showed good agreement, and suggests that this model may be useful for determining pollutant emissions from a wide variety of other sources, for estimating pollution levels in other indoor environments, and for evaluating pollutant control strategies.

35427 **(SAND—80-2175) Lagrangian measurements of sulfur dioxide to sulfate conversion rates.** Zak, B.D. (Sandia National Labs., Albuquerque, NM (USA)). May 1981. Contract AC04-76DP00789. 38p. NTIS, PC A03/MF A01. Order Number DE82000246.

On the basis of Project MISTT data and proposed homogeneous gas phase oxidation mechanisms for sulfur dioxide, it has been suggested that the degree of mixing with background air, the chemical composition of the background air, and the intensity of the sunlight available are key factors determining the rate of sulfur dioxide to sulfate conversion. These hypotheses are examined in light of Lagrangian measurements of conversion rates in power plant plumes made during the Tennessee Plume Study and Project Da Vinci. It is found that the Lagrangian conversion rate measurements are consistent with these hypotheses. It has also been suggested that the concentration of ozone may serve as a workable surrogate for the concentrations of the free radicals involved in the homogeneous gas phase mechanism. The nighttime Lagrangian data remind one that the gross difference in mean lifetime of ozone and free radicals can lead to situations in which the ozone concentration is not a good surrogate for the free radical concentrations.

35428 **(TVA/ONR/ARP—81/10) Analysis of sulfur dioxide excesses at Allen Station 7 during December 1980.** Wastrack, K.G. (Tennessee Valley Authority, Muscle Shoals, AL (USA)). Jul 1981. 49p. NTIS, PC A04/MF A01. Order Number DE81904133.

During December 1980, sulfur dioxide ($SO_2$) levels in excess of primary National Ambient Air Quality Standards (NAAQS) were measured at monitoring station 7 near the Tennessee Valley Authority (TVA) Allen Steam Plant on two occasions. $SO_2$ concentrations exceeding the 24-hour primary standard of 0.14 ppM were measured for the period ending at 1500 CST on December 1, 1980 (0.143 ppM), and at 2000 CST on December 18, 1980 (0.144 ppM). Since two excesses occurred within a single calendar year, these excesses represent a violation of the primary standard. Allen Steam Plant was in compliance with the 4.0 $lbs/10^6$ Btu $SO_2$ emission standard at the time the excess occurred. Therefore, excesses of NAAQS were unexpected and an analysis is necessary to identify the cause(s) of these excesses, with particular emphasis on possible contributions from Allen Steam Plant. This report examines the physical and environmental circumstances associated with the December incidents, documents these circumstances are completely as practical, and determines the sources in the vicinity of station 7 that were contributors to the incident. It is concluded that the Allen Steam Plant was probably not a significant contributor to the 24-hour $SO_2$ excesses measured at station 7 during November to December 1980. This conclusion is based on existing wind conditions which would not have transported the plume towards the station. The most likely case of the 24-hour $SO_2$ excesses measured at station 7, was Delta Refinery. This is based on estimated plant emissions combined with existing wind conditions which would have transported the emission toward station 7.

35429 **(UCID—18594-Rev.1) User manual for SILVA: a computer code for estimating effects of pollution on the growth and succession of western coniferous forests.** Axelrod, M.C.; Kercher, J.R. (Lawrence Livermore National Lab., CA (USA)). 1981. Contract W-7405-ENG-48. 79p. NTIS, PC A05/MF A01. Order Number DE82000134.

SILVA is a computer code developed for simulating impacts of $SO_2$ pollution on the growth and succession of western coniferous forests. SILVA has been specifically parameterized for application to the ponderosa pine and mixed conifer forests of the Sierra Nevada, California. JABOWA, a code for simulating northeastern USA forests, was used as a framework for SILVA. This user manual describes sample inputs: code structure; data, dynamic, control, and internal variables; sample output; and considerations for setup at the user's computer installation. A listing of the source program and descriptions of all subroutines and functions are presented.

35430 **(UCRL—85724) Modeling a multiple tracer release experiment during nocturnal drainage flow in complex terrain.** Lange, R. (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 9p. (CONF-811104—4). NTIS, PC A02/MF A01. Order Number DE81024414.

From AMS conference on mountain meterology; Steamboat Springs, CO, USA (10 Nov 1981).

The complex conditions posed by very localized winds and turbulence, rugged topography, variable surface roughness, strong vertical motions and gravity flow require a three-dimensional modeling approach to realistically simulate the dispersal of hydrogen sulfide injected into the atmosphere at the Geysers geothermal area. In this study the three-dimensional particle-in-cell numerical diffusion model ADPIC (Lange, 1973 and 1978) was used to simulate the transport and diffusion of two simultaneous, distinguishable fluorescent tracer releases into the nighttime drainage flow regimes of the Putah and Anderson Creeks in the Anderson Springs Valley during the night of July 24, 1979.

35431 **(UCRL—85725) Overview, current status, and future plans for the DOE atmospheric studies in complex terrain (ASCOT) program.** Dickerson, M.H. (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 5p. (CONF-811104—3). NTIS, PC A02/MF A01. Order Number DE81024417.

From AMS conference on mountain meterology; Steamboat Springs, CO, USA (10 Nov 1981).

Several terrain-dominated air-flow phenomena affect the problem of pollutant transport over complex terrain. One of these in nocturnal valley drainage flow, chosen as the initial focus of the ASCOT program. For this study we chose the Geysers geothermal area in Northern California as the initial study site. Objectives for this study were defined as, (1) to augment the present knowledge of the physical mechanisms involved in the development, perpetuation, and breakup of nocturnal drainage flows; (2) to develop an integrated measurement and modeling methodology to perform air quality impact assessment and control strategies for energy development in areas subject to drainage flows; and (3) to provide the developed methodology with special applications to the $H_2S$ emissions associated with the Geysers geothermal development. This report summarizes the field and modeling efforts that have been conducted thus far and discusses preliminary results and future plans.

35432 **(WSUN—28) Air pollution from residential wood-burning appliances: an annotated bibliography.** Shelton, J. (Western Solar Utilization Network, Portland, OR (USA)). Aug 1980. Contract AC02-79CS30159. 25p. NTIS, PC A02/MF A01. Order Number DE82000514.

This bibliography has been separated into 6 categories: a general overview; measured emissions and measured ambient air quality; state, regional and local stuies; solutions; other issues; current research. The bibliography is selective however, an attempt is made to include all works of major importance in the area of wood fuel combustion.

**35433 Equilibrium partial pressures of nitric acid and ammonia in the atmosphere.** Tang, I.N. (Brookhaven National Lab., Upton, NY). *Atmospheric Environment ;* **14**: 819-828(1980).

Water-soluble salts of sulfate and nitrate have been shown to constitute a substantial portion of the ambient aerosol. Unlike sulfuric acid which has a high affinity for water, $NH_3$ and $HNO_3$ are relatively volatile and may transfer between the gaseous phase and the suspended solution droplets. The chemical equilibrium for the $NH_3$-$HNO_3$-$H_2SO_4$-$H_2O$ system at 25°C is considered. Equilibrium partial pressures of $NH_3$ and $HNO_3$ ranging from a few hundredths to a few hundred ppbv are calculated for droplets of various sulfate and nitrate compositions. The effects of relative humidity and solution pH value on the atmospheric $NH_3$ and $HNO_3$ concentrations are studied analytically. The results indicate that, while the $HNO_3$ partial pressure depends strongly on relative humidity and the nitrate-to-sulfate ratio in solution, the $NH_3$ partial pressure varies only slightly with humidity but inversely with the hydrogen-ion concentration.

## 5003 Radioactive Materials Monitoring And Transport

*REFER ALSO TO CITATION(S) 34385, 34400, 35496*

**35434 (RHO-CD—80-35-4Q) Radioactivity in gaseous waste discharged from the separations facilities during 1980.** Aldrich, R.C.; Sliger, G.J. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 6 Feb 1981. Contract AC06-77RL01030. 57p. NTIS, PC A04/MF A01. Order Number DE82000042.

This document is issued quarterly for the purpose of summarizing the radioactive gaseous waste that are discharged from the facilities of the Rockwell Hanford Operations (Rockwell). Data on the alpha and beta emissions for the year 1980 are presented where relevant to the gaseous effluent. Emission data are not included on gaseous wastes produced within the 200 Areas by other Hanford contractors. The volume and activity estimates of the gaseous effluents are detailed on a month-to-month basis for each site, the average activity, maximum activity, and the average concentration discharged from each stack are also presented for each site. Also listed in this report is a summary table which contains a listing of the activity for the current year, from startup, and decayed from startup.

## 5005 Site Resource And Use Studies

*REFER ALSO TO CITATION(S) 34313, 34314, 34315*

## 5006 Regulations

*REFER ALSO TO CITATION(S) 35496*

# 51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

*REFER ALSO TO CITATION(S) 35522*

## 5101 Basic Studies

*REFER ALSO TO CITATION(S) 35450*

**35435 (BNL—51404) Review of Plant Taxa for listing as endangered or threatened species: compilation by State.** Nagy, J.; Calef, C.E. (Brookhaven National Lab., Upton, NY (USA)). Dec 1980. Contract AC02-76CH00016. 362p. NTIS, PC A16/MF A01. Order Number DE82000100.

On December 15, 1980, the US Fish and Wildlife Service, Department of the Interior, published a notice of review entitled Endangered and Threatened Wildlife and Plants: Review of Plant Taxa for Listing as Endangered or Threatened Species (45FR82480-82569). This report corresponds exactly with that notice but is expanded to provide individual compilations for each state of the union plus the District of Columbia, Puerto Rico, and the Virgin Islands. In addition statistical summaries by category (as defined in 45FR82480-82481) are given for each state and maps are presented which show graphically the historical occurrence by state of the taxa.

**35436 (CONF-800433—, pp 2-14) INAA advance prediction computer program: its uses in environmental and energy research.** Guinn, V.P. (Univ. of California, Irvine). 1980. NTIS, PC A99/MF A01.

From 4. international conference on nuclear methods in environment and energy research; Columbia, MO, USA (14 Apr 1980).

The instrumental neutron activation analysis (INAA) Advance Prediction Computer Program (APCP) is described, and some of its advantages and uses are presented. For any given sample matrix type of only approximately known typical or average elemental composition, the APCP rapidly computes the principal details of its Ge(Li) pulse-height spectrum; the energy and net photopeak area (and its standard deviation) of each statistically-significant peak; and all Compton levels and Compton edges produced by the various input elements - for any thermal-neutron flux, irradiation period, decay time, counting time, detector, and counting geometry specified. The APCP routinely makes such calculations for 12 stepped sets of irradiation, decay, and counting periods. For each set of conditions, the maximum allowable sample size is calculated, with subsequent calculations based on that size. INAA lower limits of detection are also readily calculated for additional elements of interest not known to be present. The program output readily shows the optimum conditions for the measurement of any element of interest in such a matrix. Experimental tests on various materials have shown that the APCP is remarkably effective. Current improvements and extensions are described, as well as a number of illustrative applications.

**35437 Beyond selection: optimal ingestion rate as a function of food value.** Taghon, G.L. (Univ. of Washington, Seattle). Contract AT06-76-EV-75026. *American Naturalist ;* **118**: No. 2, 202-214(Aug 1981).

A simple model based on microphagous feeders (animals which process their food items in bulk with little chance of selecting food items on an individual basis) has been developed to predict how ingestion rate should vary with food quality if the net time rate of gain of some measure of food quality, say energy, is to be maximized. Three variants of the model were considered, in which absorption efficiency (1) was constant, (2) decreased linearly with increased ingestion rate, or (3) decreased exponentially. The optimal ingestion rate, which maximized the net rate of energy gain, depended on food quality and increased on higher quality foods. For certain parameter values, constantly maintaining the maximum ingestion rate resulted in maximal net energy gain. Experimental results from the literature on a variety of animals are not in consistent accord with these predictions. It seems likely that uncontrolled and confounding variables, such as food composition or palatability, may obscure the effects of food quality on ingestion rate.

**35438 (EGG—1183-2403) Elk Hills endangered and threatened species program: Phase 1 progress summary.** O'Farrell, T.P. (EG and G, Inc., Las Vegas, NV (USA); EG and G, Inc., Goleta, CA (USA). Energy Measurements Group). Mar 1980. Contract AC08-76NV01183. 27p. NTIS, PC A03/MF A01. Order Number DE82000247.

The endangered San Joaquin kit fox, Vulpes macrotis mutica, and bluntnosed leopard lizard, Crotaphytus silus, are known to occur on the Elk Hills Naval Petroleum Reserve, NPR-1. An integrated, multiphased field program was designed to gather, synthesize, and interpret ecological information necessary for Biological Assessments required by the Secretary of Interior. These assessments will be used as the basis for a formal consultation with the Department of Interior to determine whether DOE activities on Elk Hills are compatible with the continued existence of the two species. Transects totalling 840 km were walked through all sections of Elk Hills to determine: (1) the presence and relative densities of endangered or threatened species; (2) past and potential impacts of NPR-1 activities on endangered and threatened species; and (3) the potential application of remote sensing for gathering necessary data.

35439 **(DOE/EV/10415—1) Development of a northern plant documentation center at the University of Alaska, Fairbanks. Progress report.** Murray, D.F. (Alaska Univ., College (USA). Inst. of Arctic Biology). [nd]. Contract AT06-80EV10415. 25p. NTIS, PC A02/MF A01. Order Number DE81030326.

The primary objective was to develop a computerized data bank of information on the Alaskan flora, based on collections at the Herbarium of the University of Alaska Museum (ALA). To maximize the effectiveness of this data bank, several collections-related activities had to be carried out prior to or concomitantly with data entry. Before the label data from the first specimen could be placed in a computer file it was mandatory that first we (1) prepare an important backlog of specimens from arctic Alaska, (2) develop the protocol for handling specimens, data input, and editing, and (3) define the categories of data to be entered and the conventions for consistent entry. Considerable effort has gone toward processng our large backlog of specimens. This work is almost completed, greatly enhancing our collection and the data bank derived from that collection. A total of 11,251 specimens have been accessioned between June 1980 and the present. With the accomplishment of these preliminary tasks, building the data bank became a matter of more or less mechanically following through various steps: select the taxonomic group to be entered, check to see that the data required are in the correct format, enter the data, edit the file, correct the file, and incorporate the file into the master file with the SELGEM programs. To data, over 2000 specimens have been logged.

## 5102 Chemicals Monitoring And Transport

*REFER ALSO TO CITATION(S) 34247, 35270, 35518*

35440 **(PB—81-103475) Biological monitoring of toxic trace metals. Volume 1. Biological monitoring and surveillance.** Jenkins, D.W. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). Sep 1980. Contract EPA-68-03-0443. 227p. NTIS, PC A11/MF A01.

The needs and priorities in using biological accumulator organisms for monitoring toxic trace metals in plants and animals are analyzed. The toxic trace metals selected for study are antimony, arsenic, beryllium, boron, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, tin, and vanadium. Data on the toxicity to humans, abundance, production, use and emissions of trace elements are presented and sources and pathways to plants and animals listed. Volume 1 of the two volumes evaluates available data for the purpose of selecting biological monitoring organisms to monitor the 14 selected toxic metals, and recommends various organisms for use in national and international monitoring systems and networks. This study is based on the data compilation in Volume 2.

35441 **(PB—81-103483) Biological monitoring of toxic trace metals. Volume 2. Toxic trace metals in plants and animals of the world. Part I.** Jenkins, D.W. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). Sep 1980. Contract EPA-68-03-0443. 512p. NTIS, PC A22/MF A01.

The needs and priorities in using biological accumulator organisms for monitoring toxic trace metals in plants and animals are analyzed. The toxic trace metals selected for study are antimony, arsenic, beryllium, boron, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, tin, and vanadium. Data on the toxicity to humans, abundance, production, use and emissions of trace elements are presented and sources and pathways to plants and animals listed. Volume 2 brings together the majority of the significant data on bioaccumulation and bioconcentration of the 14 trace metals discussed, which are considered to be of most importance to man and his food organisms. This volume provides a concise reference of baseline data for delineating the background or 'normal' levels of toxic trace metals as well as levels that occur under various pollutant conditions.

35442 **(PB—81-103491) Biological monitoring of toxic trace metals. Volume 2. Toxic trace metals in plants and animals of the world. Part II.** Jenkins, D.W. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). Sep 1980. Contract EPA-68-03-0443. 485p. NTIS, PC A21/MF A01.

The needs and priorities in using biological accumulator organisms for monitoring toxic trace metals in plants and animals are analyzed. The toxic trace metals selected for study are antimony, arsenic, beryllium, boron, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, tin, and vanadium. Data on the toxicity to humans, abundance, production, use and emissions of trace elements are presented and sources and pathways to plants and animals listed. Volume 2 brings together the majority of the significant data on bioaccumulation and bioconcentration of the 14 trace metals discussed, which are considered to be of most importance to man and his food organisms. This volume provides a concise reference of baseline data for delineating the background or 'normal' levels of toxic trace metals as well as levels that occur under various pollutant conditions.

35443 **(PB—81-103509) Biological monitoring of toxic trace metals. Volume 2. Toxic trace metals in plants and animals of the world. Part III.** Jenkins, D.W. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). Sep 1980. Contract EPA-68-03-0443. 297p. NTIS, PC A13/MF A01.

The needs and priorities in using biological accumulator organisms for monitoring toxic trace metals in plants and animals are analyzed. The toxic trace metals selected for study are antimony, arsenic, beryllium, boron, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, tin, and vanadium. Data on the toxicity to humans, abundance, production, use and emissions of trace elements are presented and sources and pathways to plants and animals listed. Volume 2 brings together the majority of the significant data on bioaccumulation and bioconcentration of the 14 trace metals discussed, which are considered to be of most importance to man and his food organisms. This volume provides a concise reference of baseline data for delineating the background or 'normal' levels of toxic trace metals as well as levels that occur under various pollutant conditions.

## 5103 Radioactive Materials Monitoring And Transport

*REFER ALSO TO CITATION(S) 34388, 34400, 34402, 35499*

35444 **(EGG—1183-1768) Aerial radiological survey of the United States Department of Energy's Pantex Plant and surrounding area Amarillo, Texas. Date of survey: October 1979.** Boyns, P.K. (EG and G, Inc., Las Vegas, NV (USA). Energy Measurements Group). Jul 1981. Contract AC08-76NV01183. 24p. NTIS, PC A02/MF A01. Order Number DE82000434.

An aerial radiological survey was conducted over the United States Department of Energy's Pantex Plant and Pantex Lake areas in October, 1979. The Pantex Plant survey covered an area of approximately 64 $km^2$. The Pantex Lake survey area was approximately 2 $km^2$. Both areas were surveyed at an altitude of 46 m (150 feet) with lines spaced at 91 m (300 foot) intervals. Several passes were also made over the shipping areas at the Amarillo International Airport. An array of sodium iodide detectors were mounted in a helicopter to collect gamma ray spectral data. As expected, the spectral data indicated the presence of several areas containing man-made sources.

35445 **(LA—8932-PR) Environmental and radiological safety studies: interaction of $^{238}PuO_2$ heat sources with terrestrial and aquatic environments. Progress report, January 1-March 31, 1981.** Waterbury, G.R. (comp.). (Los Alamos National Lab., NM (USA)). Sep 1981. Contract W-7405-ENG-36. 42p. NTIS, PC A03/MF A01. Order Number DE81032019.

The containers for $^{238}PuO_2$ heat souces in radioisotope thermoelectric generators are designed with large safety factors to ensure that they will withstand reentry from orbit and impact with

the earth and safely contain the nuclear fuel until it is recovered. Existing designs have proved more than adequately safe, but the Space and Terrestrial Division of the Department of Energy Office of Advanced Nuclear Systems and Projects continually seeks more information about the heat sources to improve their safety. The work discussed here includes studies of the effects on the heat source of terrestrial and aquatic environments to obtain data for design of even safer systems. The data obtained in several ongoing experiments are presented; these data tables will be updated quarterly. Discussions of experimental details are minimized and largely repetitive in succeeding reports. Compilations of usable data generated in each experiment are emphasized. These compilations include data from environmental chamber experiments that simulate terrestrial conditions, experiments to measure $PuO_2$ dissolution rates soil column experiments to measure sorption of plutonium by soils, and several aquatic experiments.

## 5105 Site Resource And Use Studies

*REFER ALSO TO CITATION(S) 34245, 34304, 34399, 34400, 34510*

35446 **(EGG—1183-2426) Inventory of San Joaquin kit fox on land proposed as Phase II, Kesterson Reservoir, Merced County, California.** McCue, P.; Kato, T.; Sauls, M.L.; O'Farrell, T.P. (EG and G, Inc., Las Vegas, NV (USA); EG and G, Inc., Goleta, CA (USA). Energy Measurements Group). Apr 1981. Contract AC08-76NV01183. 29p. NTIS, PC A03/MF A01. Order Number DE82000152.

A survey of potential San Joaquin kit fox, Vulpes macrotis mutica, habitat was conducted for the US Department of the Interior Water and Power Resource Service between 23 and 25 March 1981 on lands proposed as Phase II, Kesterson Reservoir, Merced County, California. Results of ground transects covering approximately 3000 acres revealed no sign (dens, tracks, or scats) of kit fox. No kit fox were observed during four night spotlight surveys. Neither completion of Phase II nor subsequent operation and maintenance activities will have any known negative impact on the endangered San Joaquin kit fox.

## 5106 Regulations

35447 **(PNL—3866) Review of soil contamination guidance.** Mueller, M.A.; Kennedy, W.E. Jr.; Soldat, J.K. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1981. Contract AC06-76RL01830. 43p. NTIS, PC A03/MF A01. Order Number DE81030662.

A review of existing and proposed radioactive soil contamination standards and guidance was conducted for United Nuclear Corporation (UNC), Office of Surplus Facilities Management. Information was obtained from both government agencies and other sources during a literature survey. The more applicable standards were reviewed, evaluated, and summarized. Information pertaining to soil contamination for both facility operation and facility decommissioning was obtained from a variety of sources. These sources included: the Code of Federal Regulations, regulatory guides, the Federal Register, topical reports written by various government agencies, topical reports written by national laboratories, and publications from the American National Standards Institute (ANSI). It was difficult to directly compare the standards and guidance obtained from these sources since each was intended for a specific situation and different units or bases were used. However, most of the information reviewed was consistent with the philosophy of maintaining exposures at levels as low as reasonably achievable (ALARA).

# 52 ENVIRONMENTAL SCIENCES, AQUATIC

*REFER ALSO TO CITATION(S) 35522*

## 5201 Basic Studies

*REFER ALSO TO CITATION(S) 34423, 35436, 35475*

35448 (ANL—80-115-Pt.3, pp 71-73) **Three-year study on the effects of enclosure on zooplankton in a large, curtained bay of ELA Lake 382.** Mellinger, D.L.; Marshall, J.S.; Malley, D.F. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

This project was initiated in May 1978 when a large (3 ha) bay of ELA Lake 382 was isolated from the rest of the lake by means of a sea curtain. The purpose of this enclosure was to provide an appropriate setting for a relatively large-scale experiment to study the fates and effects of added pollutants on aquatic communities.

35449 (ANL—80-115-Pt.3, pp 92-94) **Construction of a portable incubator for phytoplankton primary productivity studies.** Prepejchal, W.; Hall, G.B. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

To allow comparisons of primary productivity rates between field and laboratory experiments, it was necessary to have a portable incubator. The design and construction of a suitable portable incubator are discussed. (ACR)

35450 (CONF-800433—, pp 753-762) **New developments in the use of stable activable tracers in environmental science.** Loveland, W.; Keasler, K.; Ghannam, L.; Borovik, A. (Oregon State Univ., Corvallis). 1980. NTIS, PC A99/MF A01.

From 4. international conference on nuclear methods in environment and energy research; Columbia, MO, USA (14 Apr 1980).

Recent developments in the use of stable activable tracers (SATs) in environmental science are reported. (A stable activable tracer is a stable material injected into a system under study and whose concentration is measured by post-sampling activation analysis.) The activable nuclear parts of the tracers studied have been rare earth nuclides with short-lived activation products or Cu. To trace the fate of fluid-bound pollutants (and/or water masses) in marine waters, we have used anionic DTPA complexes of the rare earths. These tracers were shown to be stable (80 to 90% nondissociated) in extensive laboratory tests involving solutions of the tracer in estuarine water including large amounts of marine sediments. Results of a field study in which the flushing time and other hydrological characteristics of an estuarine marina were measured by simultaneously using a fluorescent dye and a SAT are presented. To trace the path of potentially toxic organic molecules, three stable activable tracers, dysprosium(III)-trisacetylacetonate $(DY(acac)_3 3H_2O)$, dysprosium(III)-trisdibenzoylmethane $(DY(dbm)_3 H_2O$ and copper oxinate Cu $(C_9H_6ON)_2$ were synthesized. Their octanol/water partition coefficients and their solubility in water were measured and used to correlate the tracer species and its biological activity with that of known toxic materials. In a project to demonstrate the simple use of SATs to trace the origin of common insecticides and herbicides, seven common insecticides and herbicides were marked with anionic rare earth DTPA complexes and shown to be detectable at dilutions of 1 part in $10^{12}$. Two arsenical herbicides were chosen for further study and the tracer/herbicide ratio was shown to remain constant in samples of herbicide material collected on plant surfaces and runoff waters in the environment for long periods.

35451 **Habitat partitioning and competitive displacement in cattails (Typha): experimental field studies.** Grace, J.B.; Wetzel, R.G. (Michigan State Univ., Hickory Corners). EY-76-S-02-1599. *American Naturalist ;* **118**: No. 4, 463-473(Oct 1981).

A conspicuous feature of many plant communities that is often considered evidence of competitive displacement is the segre-

gation of species along a habitat gradient. The extent of competitive displacement is examined in a recently established association of cattails (Typha latifolia L. and T. angustifolia L.). To accomplish this, potential and realized distributions of these two species were compared along a gradient of water depth in a small pond. These two species together comprised more than 95% of the plant biomass along the gradient and as such constituted a natural two-species association. Comparisons between potential and realized distributions permit a direct estimate of the reductions in abundance of each species by the presence of the other species and the reduction in potential niche overlap along the habitat gradient. In addition, the study of competitive interactions between T. latifolia and T. angustifolia provides us with an opportunity to evaluate the classification of these two species as respectively r-selected and K-selected (McNaughton 1975).

35452 **Organic carbon flow in a swamp-stream ecosystem.** Mulholland, P.J. (Univ. of North Carolina, Chapel Hill). *Ecological Monographs ;* **51**: No. 3, 307-322(1981).

An annual organic carbon budget is presented for an 8-km segment of Creeping Swamp, an undisturbed, third-order swamp-stream in the Coastal Plain of North Carolina, USA. Annual input of organic carbon (588 $gC/m^2$) was 96% allochthonous and was dominated by leaf litter inputs (36%) and fluvial, dissolved organic carbon (DOC) inputs (31%). Although the swamp-stream was primarily heterotrophic, autochthonous organic carbon input, primarily from filamentous algae, was important during February and March when primary production/ecosystem respiration (P/R) ratios of the flooded portions were near one. Annual output of organic carbon via fluvial processes (214 $gC/m^2$), 95% as DOC, was 36% of total annual inputs, indicating that the swamp-stream segment ecosystem was 64% efficient at retaining organic carbon. Organic carbon dynamics in the Creeping Swamp segment were compared to those reported for upland stream segments using indices of organic matter processing suggested by Fisher (1977) and a loading potential index suggested here. Creeping Swamp, while loading at a high rate, retains a much larger portion of its organic carbon inputs than two upland streams. Despite the high degree of retention and oxidation of organic inputs to Creeping Swamp, there is a net annual fluvial export of 21 $gC/m^2$, mostly in the dissolved form. Watersheds drained by swamp-streams in the southeastern United States are thought to have large organic carbon exports compared to upland forested drainages, because the stream network covers a much greater proportion of the total watershed area.

35453 **Intermediate nepheloid layers observed over the continental margins off Oregon.** Pak, H.; Zaneveld, J.R.V. (Oregon State Univ., Corvallis). Contract EY-76-S-06-2227. *Proceedings of the Society of Photo-Optical Instrumentation Engineers ;* **160**: 9-17(1978).

Intermediate nepheloid layers were observed by a beam transmissometer operating at 650 nm during 3 to 8 November 1976 over the continental shelf and slope off Oregon. Two well defined intermediate nepheloid layers were observed. One was located at about 150 m depth and extended westward from a point 10 NM offshore. The second was at about 375 m depth and went westward from a point 25 NM offshore. They were at least 15 NM wide (east-west dimension), and 50 to 150 m thick. They closely followed isotherms in the zonal section. The overall structure of the nepheloid layers remained unchanged during the period of the cruise. The intermediate nepheloid layers appear to have been generated by lateral diffusion and advection of turbid water from bottom nepheloid layers over the continental shelf and slope toward the deep water. Possible processes of diffusion and advection of bottom nepheloid layers to generate intermediate nepheloid layers are discussed.

## 5202 Chemicals Monitoring And Transport

*REFER ALSO TO CITATION(S) 34247, 34287, 34288, 34428, 35440, 35441, 35442, 35443, 35511*

35454 (ANL—80-115-Pt.3, pp 50-52) **Sediment resuspension processes in the Great Lakes.** Lesht, B.M.; Williams, R.M.; White, R.V. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

There is little doubt that sediment resuspension is an important process in the recycling and distribution of pollutants and nutrients in the Great Lakes. Very little is known, however, about resuspension in these waters. One objective of this work was to make enough direct observations of resuspension so that the relationship between resuspension and meteorological forcing can be understood and incorporated into ecological models. A month-long experiment was conducted (between 10 October and 8 November) in which our time-lapse camera system (TLCS) was deployed on Indiana Shoals, Lake Michigan, adjacent to our meteorological tower. We recorded continuous 15-min averages of the easterly and northerly currents during the experiment and average (15 min) transmittance once per hour. The camera was set to expose one frame every 15 min. The film record shows 10 different sediment transport events ranging in intensity from gradual migration of the sand ripples to resuspension which completely obscures the bottom.

35455 (ANL—80-115-Pt.3, pp 53-57) **Lake Michigan database analysis and model development.** Lesht, B.M. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

The US Environmental Protection Agency conducted an extensive water quality surveillance program in Lake Michigan during 1976 and 1977. This program consisted of measurements of 44 water quality parameters using samples taken at several depths at approximately 100 stations during each of 17 cruises. As part of the effort to implement and improve a numerical phytoplankton model of Lake Michigan, a statistical analysis of this database is being conducted. The statistical analysis has two major objectives. The first is to identify subsets of the database which are appropriate for calibrating and verifying the phytoplankton model. The second objective is to extract enough detailed information from the database concerning the spatial and temporal variability of the measured parameters to make possible the design of more efficient sampling schemes both for support of the model and for determination of long-term trends in water quality.

35456 (ANL—80-115-Pt.3, pp 58-63) **Concentrations of dissolved and particulate forms of trace elements in Lake Michigan's major tributaries.** Tisue, G.T.; Seils, C.A.; Warner, D.A. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

A major goal of recent studies of trace elements in the Great Lakes has been the establishment of mass balance budgets. These budgets are derived from estimates of element mass fluxes to and from the water column, including atmospheric and riverine inputs, and losses through sedimentation and outflow. The flux of several trace metals borne into the lake in dissolved and particulate forms by major tributaries was determined.

35457 (ANL—80-115-Pt.3, pp 64-67) **Lake water chemistry and zinc toxicity to plankton communities: a preliminary report.** Marshall, J.S.; Nelson, D.M.; Mellinger, D.L.; Lei, C.; Lawrence, S.G.; Malley, D.F. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

According to the preliminary (1979) EPA water quality criterion for the protection of freshwater life, the maximum permissible 24-hr average zinc concentration is a function exclusively of hardness. To assess the validity of the current zinc criterion for lakes with contrasting water hardness, two 2-week in situ experiments in Lake Michigan and two in ELA Lake 239 were conducted in July-August 1980. Hardness and other water quality parameters for these lakes are shown.

35458 (ANL—80-115-Pt.3, pp 112-117) **Modelling growth and PCB uptake of brown trout (Salmo trutta).** Jensen, A.L.; Spigarelli, S.A.; Thommes, M.M. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

It has been proposed that mathematical models be applied to routine identification of chemicals having a potential for environmental hazard. Success depends on availability or development of models that accurately predict transfer, fate, and bioconcentration. The objective of this study is to determine if PCB uptake by brown trout (Salmo trutta) can be accurately predicted using a bioenergetics uptake model. The model under study was developed for PCB and methyl mercury uptake by yellow perch (Perca flavescens). The model is being applied to predict PCB uptake by brown trout in laboratory experiments and in Lake Michigan. In the laboratory uptake was examined under three different temperature regimes. The model describes uptake in terms of exposure, which is a function of food ration and volume of water passing the gills. These factors are functions of metabolism, which is turn is determined by animal size and growth rate. Several different models were applied to model growth as a function of temperature.

35459 **(DOE/TIC—11471) Combustion: an oil spill mitigation tool. Phase II. The burning of the M/T BURMAH AGATE (ex-DANALAND).** Goodier, J.L.; Siclari, R.J. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1981. Contract AC06-76RL01830. 134p. NTIS, PC A07/MF A01. Order Number DE82000527.

The report describes a major marine casualty off the coast of Galveston, Texas. When two vessels collided, both caught fire and the tanker BURMAH AGATE burned for 69 days with extensive loss of life. The objective of this study was to determine if previous research directed towards burning an oil cargo in a stricken tanker could be a means of reducing the release of oil to the environment to protect the natural resouces of the coastline from damage from oil.

35460 **(PNL—4013) Treatment of biomass-gasification wastewaters by wet-air oxidation.** English, C.J. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1981. Contract AC06-76RL01830. 30p. NTIS, PC A03/MF A01. Order Number DE82000935.

Production of synthetic natural gas from gasification of biomass results in the generation of a high-strength wastewater that is difficult to treat by conventional means. This study investigated the use of wet air oxidation (WAO) as a treatment method for these wastewaters. A literature review was conducted to identify the suitability of WAO for the treatment of high-strength industrial wastewaters and to determine typical operating conditions for such treatment. Data presented in the literature showed that WAO should be suitable for treatment. Data presented in the literature showed that WAO should be suitable for treatment of biomass gasification wastewaters (BGW), and a laboratory treatability study was designed. BGW, having an initial chemical oxygen demand (COD) of 30,800 mg/1 and initial color of 183,000 APHA units, was treated in a laboratory autoclave for 20, 40, 60, 120, and 180 min at temperatures and pressures of 150°C, 5.1 MPa (750 psi); 200° C, 6.9 MPa (1000 psi); 250°C, 10.3 MPa (1500 psi); and 300°C, 13.8 MPa (2000 psi). Maximum COD removals of 0% for the 150°C, 5.2 MPa (750 psi) runs; 40% for the 200°C, 6.9 MPa (1000 psi) runs, 55% for the 250°C, 10.3 MPa (1500 psi) runs; and 85% for the 300° C, 13.8 MPa (2000 psi) runs were measured. Maximum color removals for these respective runs were 56%, 82%, 97%, and 99%. Initial removal rates of COD and color were observed to increase with reaction temperature. The experimental results suggest that oxidation of BGW organics by WAO occurs in a stepwise fashion with large organic molecules first being hydrolyzed and then partially oxidized to low molecular weight intermediates. Complete oxidation of these intermediates is more difficult and most easily accomplished at high reaction temperatures. The best application of WAO to treatment of BGW appears to be as a pretreatment to biological treatment and it is recommended that this application be investigated.

35461 **(PNL—4016) Treatment of biomass gasification wastewaters using liquid-liquid extraction.** Bell, N.E. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1981. Contract AC06-76RL01830. 28p. NTIS, PC A03/MF A01. Order Number DE82000711.

Pacific Northwest Laboratory (PNL) investigated liquid-liquid extraction as a treatment method for biomass gasification wastewaters (BGW). Distribution coefficients for chemical oxygen demand (COD) removal were determined for the following solvents: methylisobutyl ketone (MIBK), n-butyl acetate, n-butanol, MIBK/n-butyl acetate (50:50 vol), MIBK/n-butanol (50:50 vol), tributyl phosphate, tri-n-octyl phosphine oxide (TOPO)/MIBK (10:90 wt), TOPO/kerosene (10:90 wt), kerosene, and toluene. The best distribution coefficient of 1.3 was given by n-butanol. Chemical analysis of the wastewater by gas chromatography (GC) showed acetic acid and propionic acid concentrations of about 4000 mg/1. Methanol, ethanol, and acetone were identified in trace amounts. These five compounds accounted for 45% of the measured COD of 29,000 mg/1. Because of the presence of carboxylic acids, pH was expected to affect extraction of the wastewater. At low pH the acids should be in the acidic form, which increased extraction by MIBK. Extraction by n-butanol was increased at high pH, where the acids should be in the ionic form.

35462 **(PNL—4018) Treatment of biomass gasification wastewaters using reverse osmosis.** Petty, S.E.; Eliason, S.D.; Laegreid, M.M. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1981. Contract AC06-76RL01830. 44p. NTIS, PC A03/MF A01. Order Number DE82000698.

Reverse osmosis (RO) was evaluated as a treatment technology for the removal of organics from biomass gasification wastewaters (BGW) generated from an experimental biomass gasifier at Texas Tech University. Wastewaters were characteristically high in chemical oxygen demand (COD) with initial values ranging from 32,000 to 68,000 mg/1. Since RO is normally considered a complementary treatment technology, wastewaters were pretreated by biological or wet air oxidation (WAO) processes. One set of experiments were run using untreated wastewaters to compare membrane performance with those experiments using pretreated wastewaters. Experiments were run for 8 to 10 hrs using UOP's TFC-85 membrane operating at 700 psig and 18 to 20°C. This membrane is similar to the NS-100, a membrane known for being effective in the separation of organics from solution. Separation of organics from solution was determined by COD removal. Removal percentages for biologically pretreated wastewaters averaged 98% except for one group of runs averaging 69% removal. This exception was probably due to the presence of milk solids in the feed. Use of RO on WAO pretreated wastewaters and unpretreated feeds resulted in 90% COD removal. Membrane degradation was observed when using full-strength and WAO pretreated feeds, but not when using feeds that had undergone biological pretreatment. Color removal was computed for the majority of experiments completed. Overall, 99 to 100% of the total color was removed from BGW feeds, values which coincide with those reported in the literature for other wastewaters.

35463 **Continuous monitoring, automated analysis, and sampling procedures.** Pitt, W.W. Jr. (Oak Ridge National Lab., TN). *Journal of the Water Pollution Control Federation* ; **53**: No. 6, 675-678(Jun 1981).

This article emphasizes the the need for a well documented quality control system in waste water monitoring and sampling procedures. The US EPA has continued its strong emphasis on effluent monitoring and has published a list of 155 organic chemicals and 23 plastic or synthetic materials industries for which it proposed to require monitoring the process waste water under the Clean Water Act. (KRM)

## 5203 Radioactive Materials Monitoring And Transport

*REFER ALSO TO CITATION(S) 34388, 35445*

35464 (ANL—80-115-Pt.3, pp 19-25) **Influence of dissolved organic carbon on the sorption of plutonium to natural sediments.** Nelson, D.M.; Karttunen, J.O.; Orlandini, K.A.; Larsen, R.P. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

One prominent aspect of the environmental behavior of plutonium is a tendency for strong, though not complete, association with soil and sediments. The nature of this association is not well understood, and the water quality parameters which may affect it

have not been identified. It is assumed that adsorption is dependent upon the chemical species present (oxidation state and complex ion associations) and that the uncomplexed form of Pu(IV) is the one that is most highly sorbed. In certain oligotrophic waters the dissolved plutonium is primarily in the oxidized form (presumably as Pu(V)), a form that is weakly sorbed. This could account for its solubility. In all water, however, some of the dissolved plutonium is present in the reduced form (presumably as Pu(IV)). The apparent solubility of this reduced form, as measured by a sediment concentration factor, varies markedly among the lakes. The concentrations of dissolved organic carbon (DOC) have now been measured in the waters from a number of lakes and a general dependence of the sediment concentration factor (K/sub D/) for Pu(IV) upon DOC has become evident. In order to study the nature of this plutonium-organic complex in more detail several experiments were conducted in which the sediment concentration factor was measured as a function of DOC concentration.

**35465** (ANL—80-115-Pt.3, pp 26-28) **Oxidation state distribution of plutonium in marine waters.** Nelson, D.M.; Metta, D.N.; Larsen, R.P. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

Previous measurements have demonstrated that the dissolved plutonium in sea water exists as a mixture of two forms. The reduced form, probably Pu(IV), is strongly sorbed to suspended particulate matter while the oxidized form, probably Pu(V), is not. The distribution of plutonium between these forms will consequently be very important in determining the fate of plutonium added to the oceans. Earlier measurements showed 70 to 95% of the dissolved plutonium to be in the oxidized form, however the measurements were confined to samples collected in shallow coastal environments (the Irish Sea and the Pacific test sites). A few samples collected elsewhere around the British Isles indicated that outside the Irish Sea substantially less of the dissolved plutonium was in the oxidized form. Measurements of total plutonium concentration, but not oxidation state have been reported from the Pacific Ocean by Bowen et al. and have revealed a plutonium concentration maximum at ~ 500 m below the surface. Samples of water from the Pacific Ocean north of Hawaii were collected during May 1980 and have been analyzed for plutonium concentration and oxidation state using the lanthanum fluoride coprecipitation method.

**35466** (ANL—80-115-Pt.3, pp 29-31) **Comparison of the geochemical behavior of plutonium, thorium, and uranium in selected North American lakes.** Wahlgren, M.A.; Orlandini, K.A. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

From IAEA symposium on migration in the terrestrial environment of long-lived radionuclides; Knoxville, TN, USA (27 Jul 1981).

The distribution of fallout $^{239,240}$Pu between dissolved and suspended particulate phases has been determined in two groups of North American lakes. The lakes of the first group represent a variety of watershed conditions, ranging from an acidic bog (pH 4.8) to a highly saline lake (pH 8.7). Those of the second group have a common granitic environment and a limited pH range, but the chemical parameters of several have been significantly modified during the course of whole-lake fertilization and acidification experiments. Concurrent measurements of naturally occurring $^{232}$Th and $^{238}$U have permitted comparisons to be made between the geochemical behavior of Pu(IV) and Pu(VI) and that of their natural analogs, Th(IV) and U(VI).

**35467** (ANL—80-115-Pt.3, pp 68-70) **Sorption of $^{65}$Zn and $^{109}$Cd by seston in southern Lake Michigan.** Parker, J.I.; Stanlaw, K.A.; Kennedy, C.W. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

The recent sediment in Lake Michigan contains 2 to 3 times more zinc and cadmium than the precultural sediment, indicating an increase in the input rates in recent times. Rain water collected over Lake Michigan contains concentrations of zinc and cadmium at least 2 orders of magnitude higher than does the lake water, indicating the potential for increasing concentrations in the lake water. Plankton community bioassay experiments with zinc and cadmium show that increasing the ambient concentrations by factors of 5 or 10 results in adverse effects on algal primary productivity and zooplankton abundance. These observations suggest the potential for adverse environmental impacts of zinc and cadmium on the Lake Michigan ecosystem. The potential for increasing zinc and cadmium concentrations in the lake water is dependent primarily on the capacity of seston to sorb and transport zinc and cadmium to the bottom by sedimentation, and subsequent release from the sediment. We investigated the sorption of zinc and cadmium by seston collected at offshore stations in southern Lake Michigan. We conducted time-series experiments during different phases of the plankton successional cycle to evaluate the sorption kinetics under conditions of varying particle abundance and physiological condition of the plankton.

### 5204 Thermal Effluents Monitoring And Transport

*REFER ALSO TO CITATION(S) 34841*

### 5205 Site Resource And Use Studies

*REFER ALSO TO CITATION(S) 35446*

## 53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

### 5301 Social And Economic Studies

*REFER ALSO TO CITATION(S) 34470, 34475, 34476, 34491, 34492, 35472*

**35468** **(ORAU—181) Some employment and earnings implications of regional biomass energy utilization: New England and the Cornbelt states.** Stevenson, W.; Bell, S.E.; Blair, L.M.; Gove, R.M.; Little, J.R. (Oak Ridge Associated Universities, Inc., TN (USA)). Aug 1981. Contract AC05-76OR00033. 244p. NTIS, PC A11/MF A01. Order Number DE81030689.

Because of their abundant forest and agricultural biomass resources, New England and the Cornbelt are likely to grow considerably in the development of biomass energy systems during the next decade or two. Observations of 189 specific biomass-related operations suggest that substantial employment and earnings could be generated by this activity. Forty thousand or more permanent jobs might be created in New England's wood energy industry by the end of the century. If alcohol-fuel use continues to grow, even greater potential for employment in biomass energy exists in the Cornbelt states. The associated earnings would be quite substantial for both regions. The direct combustion of wood and activities related to alcohol-fuel production are expected to be the major contributors to biomass energy production, employment, and earnings; but other biomass systems show some potential as well. Energy extraction from municipal waste, anaerobic digestion of animal manure, and other biomass conversion systems will all generate employment as they grow in use. An important characteristic of these jobs is that they tend to be for unskilled and semiskilled workers and are likely to be concentrated in rural areas, where the stimulus to the local economy can be substantial.

**35469** **(ORNL/Sub—81/13829-5) Socioeconomic baseline characterization for the Savannah River Plant area.** (Oak Ridge National Lab., TN (USA); NUS Corp., Rockville, MD (USA)). Sep 1981. Contract W-7405-ENG-26. 541p. (NUS—3852). NTIS, PC A23/MF A01. Order Number DE82000526.

This report presents the social and economic characteristics of the environs of the Savannah River Plant (SRP). The characterization is keyed to those areas of the social and economic environment that could be impacted by the construction and operation of major facilities at SRP. The data consists of past trends and existing characteristics of the area's land use; its demographic, social, and economic profile; regional government; community services; housing, transportation; and historical, scenic, and archeological re-

sources. Published documents, reports, and brochures were the primary sources of all the data presented in this document. When current published data was unavailable, representatives of federal, state, and local agencies were contacted by telephone. Conversations were followed by letters of verification, which were reviewed and verified by the agency representative.

35470 **(ORNL/TM—7893) Socioeconomic assessment of defense waste processing facility impacts in the Savannah River Plant region.** Peelle, E.; Reed, J.H.; Stevenson, R.H. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 138p. NTIS, PC A07/MF A01. Order Number DE82000522.

The DWPF will immobilize highly radioactive defense wastes for storage on site until shipment to an approved federal repository for radioactive wastes. This document assesses the socioeconomic impacts of constructing and operating the proposed facility and presents the assessment methodology. Because various schedules and various ways of staging the construction of the DWPF are considered and because in some of these instances a large nearby construction project (the Vogtle Nuclear Power Station) may influence the socioeconomic impacts, four scenarios involving different facility options and schedules are assessed. In general, the impacts were found not to be large. In the scenario where the socioeconomic effects were the greatest, it was found that there are likely to be some impacts on schools in Barnwell County as well as a shortage of mobile homes in that county. Aiken, Allendale, and Bamberg counties are also likely to experience slight-to-moderate housing shortages. Minor impacts are anticipated for fire and police services, roads, traffic, and land use. There will be noticeable economic impact from the project. Other scenarios had fewer socioeconomic impacts.

## 5302 Assessment Of Energy Technologies

35471 **(CONF-810965—1) Risk of producing energy - and conserving it.** Inhaber, H.; Caton, G.; Gove, R. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 25p. NTIS, PC A02/MF A01. Order Number DE81030807.

From 6. international symposium on the Uranium Institute; London, UK (Sep 1981).

The idea that society can have a free lunch in the form of a risk-free energy system is rapidly fading away. All energy systems have some risk to human health, and for some it can be substantial. Nuclear power seems to have both a low occupational and public risk compared to other forms. In addition to this, some original research is presented with calculations on some of the risk associated with sealing up houses to keep heat in. When the effects of the accumulated radon is included, the risk per unit energy saved for this form of conservation can be great. Indeed, it appears to be much greater than the public risk of nuclear power.

35472 **(DOE/EP/10012—1) Energy and environmental quality: case histories of impact management.** (Urban Systems Research and Engineering, Inc., Cambridge, MA (USA)). Jun 1981. Contract AC01-79EV10012. 117p. NTIS, PC A06/MF A01. Order Number DE81028435.

A discussion of energy source devlopments and environmental protection dealing with impacts, and legal aspects of pollution controls and resource management, and case history studies of major energy projects is presented. (DLS)

35473 **Environment/energy tradeoffs as a process--the development of a policy analysis screening system (PASS).** House, P.W.; Williams, E.R. (US DOE, Washington, DC). pp 569-584 of Energy systems analysis, proceedings of the international conference, 1979. Kavanagh, R. (ed.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1980).

From Energy systems analysis international conference; Dublin, Ireland (9 Oct 1979).

The conduct of environmental energy tradeoff analyses to support policy development was the basis for the authors to define a set of typical problems taken from actual experience and to characterize the classes of the data used to support these analyses. They found that for all levels of policy analysis result in our consideration of energy systems as constrained by regulatory and institutional impacts with the measurement being made in terms of a set of regional environmental outcome projections.

# 55 BIOMEDICAL SCIENCES, BASIC STUDIES

## 5501 Behavioral Biology

35474 (ANL—80-115-Pt.3, pp 102-106) **Thermal experience of brown trout residing near heated discharges.** Spigarelli, S.A.; Thommes, M.M.; Prepejchal, W.; Goldstein, R.M. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

Many ectothermic animals normally experience diel thermocycles as the result of vertical or horizontal migrations. Considerable effort has been expended to evaluate the adaptive significance of such behavior. Normally, brown (Salmo trutta) and rainbow (Salmo gairdneri) trout inhabit inshore waters of Lake Michigan and do not experience large diel temperature fluctuations. However, when encountering heated discharges, these species thermoregulate to the extent that integrated thermal dose and selected temperature are intermediate between maximum and minimum available temperatures, indicating two possible strategies for thermoregulation: (1) selection and acclimation to a particular preferred temperature of (2) partitioning of time between heated and cool waters to obtain an intermediate thermal dose. These preliminary findings led to a three-year study to determine temperature-orientation behavior of trout residing near thermal discharges. Radiotelemetric techniques developed by ANL were employed to monitor internal body temperature and temperature of waters occupied by brown and rainbow trout. This report discusses the variations in temperature experienced by brown trout and some possible explanations for the observed behavior.

35475 **(DOE/TIC—11490) Predation of Chaoborus punctipennis on larvae of Dorosoma.** Dailey, N.S. (Tennessee Technological Univ., Cookeville (USA)). 1981. Contract AC05-76OR00033. 156p. NTIS, PC A08/MF A01. Order Number DE81031986.

Thesis.

Laboratory and field studies were conducted to evaluate the significance of predation of Chaoborus punctipennis on Dorosoma larvae. Only third (III) and fourth (IV) instars of Chaoborus consumed shad larvae in the laboratory studies. Second (II) instars, prepupae, and pupae of Chaoborus did not consume shad during the tests. Predation was directly related to shad density and Chaaborus size, but was not related to age (or size) of yolk-sac Dorosoma or to temperature in the range of 20 to 25°C prevalent during shad spawning. Analysis of evening plankton samples collected in Blue Springs Cover, Watts Bar Reservoir, Tennessee, during the shad spawning season, suggested that interactions between the two species were reduced by spatial, temporal, and seasonal separation. Shad larvae were most abundant near the water surface, particularly near the shoreline and near dawn; III and IV instar Chaoborus were most abundant at 3 or 5 meter depths below the surface and highest concentrations were in deeper water areas, between 2100 to 0300. In Blue Springs Cover in 1980, densities of shad and Chaoborus were too low to expect predation to occur based on the extrapolation of predation rates derived from the laboratory studies. This conclusion received further support from the fact that no signs of shad larvae were found in the crops of narcotized Chaoborus collected in Blue Springs Cove. These studies do, however, suggest conditions under which Chaoborus predation could affect larval Dorosoma mortality in other years in Blue Springs Cover or in other areas where Chaoborus and Dorosoma co-occur.

## 5502 Biochemistry

*REFER ALSO TO CITATION(S) 34423, 35295, 35484, 35490, 35518*

**35476** (DOE/ER/10044—T1, pp 31p, Attachment B) **Light path of carbon reduction in photosynthesis.** Fong, F.K. 15 Jul 1981. NTIS, PC A15/MF A01. Order Number DE81025882.

In Progress report to the Department of Energy in support of basic energy and policy research.

In this paper a mechanism for the light path of electron flow from water splitting to the pentose phosphate cycle for carbon dioxide reduction in photosynthesis is suggested. Molecular models for the P680 and P700 reaction center Chl a aggregates are described. It is shown that physiological observations of the P680 light reaction are indicative of a two-quantum photoupconversion mechanism, and that $CO_2$ assimilation and reduction in vivo is a light process, contrary to an earlier suggestion of a dark path for carbon assimilation under photosynthetic conditions. The proposed interplay of primary and secondary effects of the P680 and P700 chlorophyll light reactions is shown to be compatible with the limiting values of quantum requirement for oxygen evolution under high and low flux conditions. It is postulated that the photoreduction of 3-phosphoglyceric acid (PGA) as a result of the chlorophyll light reactions triggers a reversal of the available metabolic mechanisms for carbohydrate degradation in activating the in vivo process of solar energy conversion and storage. The role of PGA as a photoregulating agent and primary reactant in photosynthesis is discussed.

**35477** (DOE/EV/02403—T1) **Regulation of nucleic acid and protein synthesis: a background study related to the biological effects of radiation. Final report on research activities.** (Massachusetts General Hospital, Boston (USA)). 1979. Contract AS02-76EV02403. 5p. NTIS, PC A02/MF A01. Order Number DE82000396.

The existence of an intricate interplay of nucleic acids and nucleotides in the chain of events leading from free amino acid to completed polypeptide chain has been determined. To this was added another participant to the nucleotides in protein synthesis - diadenosine-5′, 5‴, p′p⁴-tetraphosphate (Ap4A). $Ap_4A$ serves as an initiation primer for DNA synthesis in a eukaryotic system catalyzed by DNA polymerase $\alpha$. Thus the initial step in protein synthesis is linked to the first step in DNA synthesis by a small molecular weight, unique dinucleotide signal. Advances in the methodology of nucleic acid sequencing have made it possible to examine the relationship between specific short segments of DNA and RNA and their function in the metabolism of the living cell. The triester method of synthesizing deoxynucleotide polymers has made it feasible to synthesize and use specific oligomeric deoxynucleotide sequences as probes of genetic function and potential viral inhibitors. The synthesis of ribonucleotide polymers has been more difficult, due almost entirely to the presence of the 2′ ribosyl hydroxyl group. The possibility is now emerging, however, of employing ribonucleotide polymers as specific RNA-virus inhibitors.

**35478** (DOE/EV/05888—T2) **Staphylococcus aureus protease: a probe of exposed, non-basic histone sequences in nucleosomes.** Rill, R.L.; Oosterhof, D.K. (Florida State Univ., Tallahassee (USA)). 1980. Contract AS05-78EV05888. 27p. NTIS, PC A03/MF A01. Order Number DE81030486.

The digestion of histones in chicken erythrocyte nucleosome cores and chromatin by Staphylococcus aureus protease was examined. This protease cleaves specifically at acidic residues and prefers glu-X bonds under the conditions used. Only 1 of 24 glutamic and 2 of 13 aspartic acids among all four core histones are located in basic, amino-terminal tails, hence staph. protease is a highly specific probe of exposed non-basic sequences. Staph. protease readily degraded H1, H5, and H3; moderately degraded H2b, and only slightly degraded H2a and H4 in nucleosomes and nucleosome cores. Electrophoresis of core histone fragments from limited digests showed that most glutamic acids were inaccessible, but at least five sites in non-basic sequences were readily cleaved. Tentative assignments of these fragments based on comparisons with products from limited digests of pure histones suggested that most accessible sites in nucleosome cores occur in H3. The most probable sites of H3 cutting are glutamic acids at positions 51, 60, 73, 94, and 97. At least one site in H2b, probably the equivalent of glu-105 in the calf H2b sequence, was accessible. No sites in H2a and H4 appeared highly accessible. H5 was readily cleaved at a site near the amino-terminus. These data substantiate the other evidence that non-basic core histone sequences are located primarily in the nucleosome interior, but that H3 binds to the ends of core DNA and thereby is partly exposed as the upper and lower surfaces of the disk-shaped core.

**35479** **(DOE/EV/10268—2) Small unilamellar vesicles as reagents: a chemically defined, quantitative assay for lectins.** Rando, R.R. (Harvard Medical School, Boston, MA (USA). Dept. of Pharmacology). 1981. Contract AC02-79EV10268. 17p. NTIS, PC A02/MF A01. Order Number DE81030365.

Samll unilamellar vesicles containing synthetic glycolipids can be prepared. These vesicles are aggregated by the appropriate lectin (Orr et al., 1979; Rando and Bangerter, 1979; Slama and Rando, 1980). It is shown here that extent of aggregation of these vesicles as measured by light scattering at 360 nm, is, under certain conditions, linear with amount of lectin added. This forms the basis of a rapid and simple quantitative assay for lectins using the modified vesicles as a defined chemical substrate. The assay is sensitive to lectin concentrations in the low $\mu$g range. The assay is applied here to studies on concanavalin A, Ricinus communis agglutinin and the $\alpha$-fucosyl binding lectin from Ulex europaeus (Type I).

**35480** **(EPRI-EA—1910-Vol.6) Aircraft data summaries for the SURE intensives. Final report.** Keifer, W.S.; Blumenthal, D.L.; Tommerdahl, J.B.; McDonald, J.A.; Strong, R.B.; White, J.H. (Meteorology Research, Inc., Santa Rosa, CA (USA); Research Triangle Inst., Research Triangle Park, NC (USA)). Sep 1981. 184p. NTIS, PC A09/MF A01. Order Number DE82900355.

As part of the EPRI sulfate regional experiment (SURE), Meteorology Research, Inc., (MRI) and Research Triangle Institute (RTI) conducted six air quality sampling programs in the eastern United States using instrumented aircraft. This volume includes the air quality and meteorological data obtained during the October 1978 intensive when MRI sampled near the Giles County, Tennessee, SURE Station and RTI sampled near the Duncan Falls, Ohio, SURE Station. Sampling data are presented for all measured parameters.

**35481** **Rates of incorporation of radioactive molecules during the cell cycle.** Gray, J.W. (Lawrence Livermore National Lab., CA); Pallavicini, M.G.; George, Y.S.; Groppi, V.; Look, M.; Dean, P.N. Contract W-7405-ENG-48. *Journal of Cellular Physiology ;* **108**: No. 2, 135-144(Aug 1981).

We report measurements of the incorporation of radioactive molecules during short labeling periods, as a function of cell-cycle stage, using a cell-sorter-based technique that does not require cell synchronization. We have determined: (1) tritiated thymidine ($^3$H-TdR) incorporation throughout S-phase in Lewis lung tumor cells in vitro both before and after treatment with cytosine arabinoside; (2) $^3$H-TdR incorporation throughout S-phase in KHT tumor cells in vitro and in vivo; (3) $^3$H-TdR incorporation throughout S-phase in Chinese hamster ovary cells and compared it with DNA synthesis throughout S-phase; (4) a mathematical expression describing $^3$H-TdR incorporation throughout S-phase in Chinese hamster M3-1 cells; and (5) the simultaneous incorporation of $^3$H-TdR and $^{35}$S-methionine as they are related to cell size and DNA content in S49 mouse lymphoma cells. In asynchronously growing cells in vitro and in vivo, $^3$H-TdR incorporation was generally low in early and late S-phase and highest in mid-S-phase. However, in Lewis lung tumor cells treated with cytosine arabinoside $^3$H-TdR incorporation was highest in early and late S-phase and lowest in mid-S-phase. Incorporation of $^{35}$S-methionine increased continuously with cell size and DNA content. Incorporation of $^3$H-TdR in CHO cells was proportional to DNA synthesis.

35482 **Circular dichroism and fluorescence-detected circular dichroism of deoxyribonucleic acid and poly[d(A-C).d(G-T)] in ethanolic solutions: a new method for estimating circular intensity differential scattering.** Reich, C. (Univ. of California, Berkeley); Maestre, M.F.; Edmondson, S.; Gray, D.M. Contract W-7405-ENG-48. *Biochemistry ;* **19**: No. 23, 5208-5213(1980).

A method is presented for determining the circular dichroism (CD) of systems whose CD spectra contain contributions from CD differential scattering. The technique is shown to detect light over $4\pi$ steradians, and thus, for the first time, a complete correction for scattering is possible. The method is applied to ethanol-condensed DNA and poly[d(A-C).d(G-T)]. From the results obtained, the former are proposed to have an A-type secondary structure. The condensed polynucleotide particles are shown to exhibit behavior similar to that of cholesteric liquid crystals. CD difference spectra, obtained from the scattering corrections and showing the contributions to different sections of the scattering envelope, are displayed. It is asserted that these scattering patterns contain information about the tertiary structure of the condensed DNA particles studied.

35483 **Polarizability of macromolecules in solution.** Petty, H.R. (Harvard Univ., Cambridge, MA); Baird, J.K. Contract W-7405-ENG-26. *Journal of Theoretical Biology ;* No. Vol. 80, 295-299(1979).

The applications of different techniques to the determination of the polarizability of molecules to arrive at an understanding of the interactions of small hydrophobic molecules, polymers, and microfilaments are noted. The limitations of the Lorentz-Lorenz equation in its application to analysis of data for proteins are pointed out. The applicability of the Bottcher-Onsager equation to aqueous solutions of macromoleculs to offset the concentration dependence of the Lorentz-Lorenz equation is assessed. From studies of aqueous solutions containing glycine, urea the complex ion $SiO_4(WO_3)_{12}^{-4}$, and the halide ions, it was concluded that values of the polarizability of the molecules obtained from the Lorentz-Lorenz equation was greater than values obtained from the Bottcher-Onsager equation. The values differed by amounts from a few % to 44%. It is felt that the same situation will likely pertain to measurements of bimolecules such as proteins. (BLM)

## 5503 Cytology

*REFER ALSO TO CITATION(S) 35481, 35486*

35484 **(DOE/EV/10270—T1) Marrow tumor interactions: the role of the bone marrow in controlling chemically induced tumors. Progress report, July 1, 1980-July 31, 1981.** Klimpel, G.R.; Scuderi, P.; Pollack, S.B.; Ching, L.M.; Mule, J.J.; Lee, M.Y. (Washington Univ., Seattle (USA)). 1981. Contract AT06-79EV10270. 23p. NTIS, PC A02/MF A01. Order Number DE81030317.

Progress is outlined below. (1) Bone marrow has been shown to uniquely contribute to the neutralization of immunogenic, chemically induced neoplasms by producing Natural Tumor Growth Regulatory cells. These cells are not differentiated T or B lymphocytes, recognizable by conventional markers, nor are they apparently macrophages. Current work will characterize these cells. (2) Experimental evidence shows that the bone marrow can generate cytotoxic T lymphocytes in vitro on a much larger scale than previous systems have been able to document. The development and refinement of in vitro assays will resolve what role each of these cell types contributes to the antitumor effect mediated by bone marrow cells. (3) CE mammary carcinoma has been shown not to generate immunity detectable by conventional assays. Studies will continue to test whether or not the mammary carcinoma engages immune responses, perhaps through the expression of viral antigens. (4) The development of immunogenic methylcholanthrene induced sarcomas in BALB/c x CE F1 mice which support the mammary carcinoma now enables testing whether or not growing neoplasms influence bone marrow functions. (5) Tests have demonstrated that the mammary carcinoma alters cell populations of lymphocytes in lymphoid organs and is mainly a consequence of reduced lymphocyte production by the bone marrow. (6) Studies continue on the effect tumors exert on hemopoiesis.

## 5504 Genetics

*REFER ALSO TO CITATION(S) 35515*

35485 **(BNL—30027) Heterogeneity and expression of the zein storage protein gene family of maize.** Burr, F.; Burr, B. (Associated Universities, Inc., Washington, DC (USA); Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 13p. (BIO—3764; CONF-8104110—1). NTIS, PC A02/MF A01. Order Number DE81030735.

From Stadler genetics symposium; Columbia, MO, USA (10 Apr 1981).

The storage protein zein is synthesized by polysomes on the endoplasmic reticulum in certain cells of the maize seed. As zein accumulates within the membrane lumen the cisternae are transformed into vesiculate protein bodies. Zein is comprised of a large family of structurally related polypeptides that fall into two classes of 19,000 and 22,500 daltons. On two dimensional IEF:SDS polyacrylamide gels, the number and positions of the electromorphs within each class differ greatly from one strain to another. Typically, however, there may be 8 to 12 spots for each class. Within any strain that has been examined the polypeptides constituting each molecular weight class have a similar amino-terminal sequence, but there are a number of position differences when the sequences are compared between strains. An in vitro system using maize endosperm membranes has been developed to study the synthesis and processing of maize preproteins. Assessment of the products made indicates that the method faithfully recapitulates the in vivo processes. Cloned cDNA zein sequences were employed to examine the extent of genetic heterogeneity. Based on restriction analyses and dot hydridizations, eighteen zein clones could be divided into three classes for the light zein class and two for the heavy zein class. The Southern transfer hydridizations showed a very complex picture that suggests that zein is encoded by many genomic sequences which share partial homologies. Many more sequences are recognized than there are polypeptides. Possibly some of these represent relic sequences and pseudogenes but until more is known about the structures of the different zein genes, an estimate of the number of copies in the maize genome by hydridization with cloned sequences cannot be made.

35486 **(DOE/ER/10715—T1) Seed-protein genes and the regulation of their expression. Progress report.** Larkins, B.A.; Hodges, T.K.; Foard, D.E.; Tomes, M.L. (Purdue Univ., Lafayette, IN (USA). Dept. of Botany and Plant Pathology). Aug 1981. Contract AC02-80ER10715. 8p. NTIS, PC A02/MF A01. Order Number DE81030165.

Research during the past year focused on two aspects of seed protein research. One objective explored the possibility of using Xenopus laevis oocytes as a potential system for studying expression of cloned storage protein genes. A second objective developed methods for isolating and partially purifying mRNAs directing the synthesis of the low molecular weight protease inhibitors of soybean seeds.

## 5505 Metabolism

*REFER ALSO TO CITATION(S) 34423, 34506*

## 5506 Medicine

35487 **(DOE/EV/02777—5) Evaluative studies in nuclear medicine research. Emission-computed tomography assessment. Progress report 1 January-15 August 1981.** Potchen, E.J. (Michigan Research Center, Inc., East Lansing (USA)). 15 Aug 1981. Contract AS02-76EV02777. 18p. NTIS, PC A02/MF A01. Order Number DE81030168.

Questions regarding what imaging performance goals need to be met to produce effective biomedical research using positron emission computer tomography, how near those performance goals are to being realized by imaging systems, and the dependence of currently-unachieved performance goals on design and operational factors have been addressed in the past year, along with refinement

of economic estimates for the capital and operating costs of a PECT research facility. The two primary sources of information have been solicitations of expert opinion and review of current literature. (ACR)

35488 **(DOE/EV/04533—T2) Technical progress report FY 81, November 1, 1981-September 30, 1982.** Saenger, E.L. (Society of Nuclear Medicine, New York (USA)). 1981. Contract AS02-77EV04533. 89p. NTIS, PC A05/MF A01. Order Number DE81030067.

Research progress for fiscal year 1981 is reported. Activity has centered on completion of data collection, data editing, attempts to resolve problems of bias in the sample, and preliminary analysis. (ACR)

## 5507 Microbiology

*REFER ALSO TO CITATION(S) 34423, 34436, 34445, 34446, 34448, 34455, 34456, 34479, 34480, 34508, 34523*

## 5509 Pathology

35489 (CONF-800433—, pp 449-458) **In vivo neutron activation analysis in a study of cadmium and hypertension in South Wales.** Morgan, W.D. (Brookhaven National Lab., Upton, NY); Cummins, P.E.; Elwood, P.C.; Evans, C.J.; Dutton, J.; Sivyer, A. 1980. NTIS, PC A99/MF A01.

From 4. international conference on nuclear methods in environment and energy research; Columbia, MO, USA (14 Apr 1980).

There is conflicting evidence concerning the influence of cadmium on the incidence of essential hypertension. Blood and urine are not very good indicators of body burden, and furthermore, the importance in such studies of matching for age and smoking habit has often been overlooked. In this respect, the technique for cadmium measurements in vivo by neutron capture prompt gamma analysis has many advantages. Fast neutron irradiation of a subject generates a thermal neutron flux at depths within the body such that capture reactions may occur. These will take place predominantly with hydrogen but also with cadmium and other body elements depending upon their cross-section and tissue abundance. The characteristic 559 keV prompt gamma rays from cadmium are detected using a 21% efficient Ge(Li) detector which is shielded against neutron and gamma radiation emerging both from the source and shield and from the subject. A detection limit (2 s.d. of the background) of 3.2 mg cadmium in the kidney is achieved for an organ dose of 0.3 rem delivered in 33 min. A study of 30 hypertensive subjects and 30 controls, matched for age, sex and smoking habit, has shown a mean kidney cadmium content of 3.3 +- 2.3 mg in the hypertensives which is not significantly different from the 4.4 +- 2.7 mg in the controls. However, in 13 pairs of non-smokers within the study, the mean value of 2.4 +- 2.5 mg in the hypertensives was significantly ($p < 0.05$) lower than the 3.9 +- 1.2 mg observed in the controls. Since the hypertensive patients had been treated for several years this raises the question of whether such therapy has reduced the level of renal cadmium below that which might be found in untreated hypertensives. Finally, the study confirmed the previously reported association between cigarette smoking and cadmium burden.

## 5510 Physiological Systems

35490 (DOE/ER/10044—T1, pp 15p, Attachment D) **Mechanisms of plant cell enlargement in gymnosperms. Final report.** 15 Jul 1981. NTIS, PC A15/MF A01. Order Number DE81025882.

In Progress report to the Department of Energy in support of basic energy and policy research.

Some of the biochemical and physiological changes that accompany cell growth have been investigated in cells of several woody gymnosperms, the major sources of potential biomass. Such growth processes have been studied extensively in many angiosperm species, but not in gymnosperms. Therefore, fundamental studies were performed to develop a model system from loblolly pine (Pinus taeda L) hypocotyls and suspension cultures from calli derived from these hypocotyls. The goals of this work were to: determine how these plant cells integrate osmoregulation, cell wall loosening, and cell wall synthesis; determine how plant growth regulators and environmental stimuli modify such processes; analyze the polysaccharide components of gymnosperm cell walls; examine the pattern of polysaccharide deposition and determine how growth regulators and environmental stimuli modify such a pattern; and determine biochemical mechanisms of cell wall polysaccharide synthesis.

35491 **(DOE/EV/04157—T1) Studies in extrarenal erythropoiesis: biochemical characteristics of a sialoerythropoietic factor discovered in adult male mice.** Walmer, D.K. (North Carolina Univ., Chapel Hill (USA). Dept. of Biochemistry). 1979. Contract AS05-76EV04157. 95p. NTIS, PC A05/MF A01. Order Number DE81030837.

Thesis.

Studies by Zangheri and Alvarez-Ugarte have demonstrated that the production of extrarenal erythropoietin was significantly impaired ($p < 0.05$) following the surgical removal of submandibular glands in young and adult male rodents. The impairment was more dramatic in the young than in the adult rodents. The studies reported herein were performed to determine the existence of factors either stimulating erythropoiesis (ESF) or generating erythropoietin (EGF) in the submandibular tissue of adult male mice. Male CF-1 mice exposed to 15 h of hypoxic hypobaria (0.45 atm) served as the submandibular tissue-donors. Neither EGF nor lipid-soluble ESF could be detected in the submandibular supernatants with the exhypoxic polycythemic mouse assay. An ESF of submandibular origin which we have referred to as the sialoerythropoietic factor was found to be nondialysable, soluble at pH 5.0, and precipitate between 35 and 50% saturation with ammonium sulfate. Attempts to determine whether or not the sialoerythropoietic factor(s) contained an erythropoietin moiety were unsuccessful. The mode of action and erythropoietic specificity of the sialoerythropoietic factor(s) were investigated.

35492 **(DOE/EV/04157—T2) Erythropoietic activity in renal homogenates.** Waggoner, W.G. Jr. (North Carolina Univ., Chapel Hill (USA). Dept. of Biochemistry). 1974. Contract AS05-76EV04157. 70p. NTIS, PC A04/MF A01. Order Number DE81030838.

The effects of castration on erythropoiesis in the polycythemic male mouse was investigated. The sensitivity of the castrated mouse for use in the bioassay of erythropoietin was examined. The light mitochondrial fraction of hypoxic rat kidney known to contain the renal erythropoietic factor (REF) was tested in a number of experimental designs and the resulting degree of erythropoietic stimulation compared among the groups.

35493 **(DOE/EV/04157—T3) Studies in erythropoiesis: the influence of the glycocalyx of the red cell membrane.** Franco, M.W. (North Carolina Univ., Chapel Hill (USA). Dept. of Biochemistry). 1980. Contract AS05-76EV04157. 148p. NTIS, PC A07/MF A01. Order Number DE81030668.

Thesis.

The possible existence of a correlation between the removal from the circulation of aged cells and the production of new RBCs was investigated. An erythropoietic influence was found to be associated with the glycocalyx of the erythrocyte membrane. The influencing factor, presumably a desialated glycopeptide, asialoglycophorin, appeared to be masked on the young RBC by an amino ketosugar, sialic acid. Ostensibly during the aging process, an increasing amount of sialic acid becomes removed from the membrane to expose the underlying erythropoietic message. Sialic acid was removed enzymatically in vitro from the membranes of erythrocytes by incubation with neuraminidase from Clostridium Perfringens. Erythropoietic activity was assayed by measuring iron-59 uptake after injection or transfusion of test material into exhypoxic mice. The amount of erythropoietic activity was found to be directly related to the number of desialated erythrocytes transfused and to the degree of desialation of the transfused erythrocytes. Asialoglycophorin was shown to be an erythrocyte stimulating factor following its isolation from the membrane and subsequent injection into test mice. Both mouse and human asialoglycophorin were found to be stimulatory.

35494 **Intestinal barrier to large particulates in mice.** LeFevre, M.E.; Hancock, D.C.; Joel, D.D. (Brookhaven National Lab., Upton, NY). *Journal of Toxicology and Environmental Health ;* 6: 691-704(1980).

Intestinal barrier function in mice was assessed after acute or chronic oral administration of 15.8- and 5.7-μm synthetic spherical particles. The results failed to confirm previous reports that ingested particles rapidly appear in blood. Furthermore, 15.8-μm particles did not accumulate in intestinal Peyer's patches, mesenteric lymph nodes, or other organs of the reticuloendothelial system, even after the maximum dosage of 8 x $10^6$ particles per day for 60 d. However, the 5.7-μm particles were demonstrated in Peyer's patches, mesenteric lymph nodes, and lungs after the maximum dosage of 4.5 x $10^5$ particles per day for 60 d. At 77 d after the termination of ingestion, 5.7-μm particles were still present in these tissues. The 5.7-μm particles were not found in spleen; retention in liver was equivocal. The site of uptake of particles capable of penetrating the intestinal mucosa appears to be the Peyer's patches. It is suggested that most absorbed particles are sequestered in Peyer's patch macrophages. Particles that escape sequestration are transported by lymph rather than by portal blood. The findings indicate that hazards associated with intestinal uptake of large (> 5 μm) particulates exist, but that the frequency of such penetration is still unclear.

### 5520 Public Health

*REFER ALSO TO CITATION(S) 35410, 35411, 35472, 35489*

### 5530 Agriculture And Food Technology

*REFER ALSO TO CITATION(S) 34506, 34509*

## 56 BIOMEDICAL SCIENCES, APPLIED STUDIES

### 5601 Radiation Effects

*REFER ALSO TO CITATION(S) 35241*

35495 **(BNL—30056) Repair of radiation damage in mammalian cells.** Setlow, R.B. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 16p. (BIO—3766; CONF-810873—2). NTIS, PC A02/MF A01. Order Number DE81030824.

From NATO CNEN conference; Rome, Italy (24 Aug 1981).

The responses, such as survival, mutation, and carcinogenesis, of mammalian cells and tissues to radiation are dependent not only on the magnitude of the damage to macromolecular structures - DNA, RNA, protein, and membranes - but on the rates of macromolecular syntheses of cells relative to the half-lives of the damages. Cells possess a number of mechanisms for repairing damage to DNA. If the repair systems are rapid and error free, cells can tolerate much larger doses than if repair is slow or error prone. It is important to understand the effects of radiation and the repair of radiation damage because there exist reasonable amounts of epidemiological data that permits the construction of dose-response curves for humans. The shapes of such curves or the magnitude of the response will depend on repair. Radiation damage is emphasized because: (a) radiation dosimetry, with all its uncertainties for populations, is excellent compared to chemical dosimetry; (b) a number of cancer-prone diseases are known in which there are defects in DNA repair and radiation results in more chromosomal damage in cells from such individuals than in cells from normal individuals; (c) in some cases, specific radiation products in DNA have been correlated with biological effects, and (d) many chemical effects seem to mimic radiation effects. A further reason for emphasizing damage to DNA is the wealth of experimental evidence indicating that damages to DNA can be initiating events in carcinogenesis.

35496 **(CONF-810905—10) CRRIS: a computerized radiological risk-investigation system.** Baes, C.F. III; Miller, C.W. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01. Order Number DE82000136.

From ANS/ENS topical meeting on probabilistic risk assessment; Post Chester, NY, USA (20 Sep 1981).

The US Environmental Protection Agency (EPA) is responsible for regulating radioactive airborne effluents in the US. A comprehensive, integrated Computerized Radiological Risk Investigation System (CRRIS) is being developed to support EPA's radiation standards development. This modular system consists primarily of five computer codes and their supporting data bases for estimating environmental transport and radiation doses and risks. Health effects are estimated on the basis of a life-table methodology developed by EPA. CRRIS is designed to provide EPA with a reasonable and flexible way of assessing the risk to man associated with radionuclide releases to the atmosphere.

35497 **(DPSPU—81-30-3) Putting radiation in perspective. Appendix A. Savannah River Chapter, Health Physics Society, public lecture.** Cofer, C.H. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jun 1981. Contract AC09-76SR00001. 17p. (CONF-8106144—7). NTIS, PC A02/MF A01. Order Number DE81030859.

From Health Physics Society annual meeting; Louisville, KY, USA (21 Jun 1981).

The Savannah River Chapter of the Health Physics Society has prepared and presented lectures to more than 20 civic groups in the Central Savannah River Area during the last half of 1980. The purpose of the lectures is to improve public understanding of the risks associated with ionizing radiation. Methods of preparation and presentation of the lectures are discussed along with methods used to obtain speaking invitations. Excerpts from the lectures, response to the lectures, and some typical questions from the question and answer sessions are also included.

35498 **(ORNL/TM—7928) INTDOS: a computer code for estimating internal radiation dose using recommendations of the International Commission on Radiological Protection.** Ryan, M.T. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 25p. NTIS, PC A02/MF A01. Order Number DE82000507.

INTDOS is a user-oriented computer code designed to calculate estimates of internal radiation dose commitment resulting from the acute inhalation intake of various radionuclides. It is designed so that users unfamiliar with the details of such can obtain results by answering a few questions regarding the exposure case. The user must identify the radionuclide name, solubility class, particle size, time since exposure, and the measured lung burden. INTDOS calculates the fractions of the lung burden remaining at time, t, postexposure considering the solubility class and particle size information. From the fraction remaining in the lung at time, t, the quantity inhaled is estimated. Radioactive decay is accounted for in the estimate. Finally, effective committed dose equivalents to various organs and tissues of the body are calculated using inhalation committed dose factors presented by the International Commission on Radiological Protection (ICRP). This computer code was written for execution on a Digital Equipment Corporation PDP-10 computer and is written in Fortran IV. A flow chart and example calculations are discussed in detail to aid the user who is unfamiliar with computer operations.

35499 **Imprecision of dose predictions for radionuclides released to the environment: an application of a Monte Carlo simulation technique.** Schwarz, G.; Hoffman, F.O. (ORNL). *Environment International ;* 4: No. 4, 289-297(1980).

An evaluation of the imprecision in dose predictions for radionuclides has been performed using correct dose assessment models and knowledge of model parameter value uncertainties. The propagation of parameter uncertainties is demonstrated using a Monte Carlo technique for elemental iodine 131 transported via the pasture-cow-milk-child pathway. Results indicated that when site-specific information is unavailable, the imprecision inherent in the predictions for this pathway is potentially large. (3 graphs, 25 references, 5 tables)

35500 (SAND—81-1695) **Beneficial uses of nuclear waste program sewage-sludge irradiation project. Progress report, October 1980-March 1981.** (Sandia National Labs., Albuquerque, NM (USA)). Aug 1981. Contract AC04-76DP00789. 96p. NTIS, PC A05/MF A01. Order Number DE82000440.

The objective of the Sewage Sludge Irradiation Project is the further development and transfer of sludge irradiation technology to the municipal sector. Sludge irradiation is beneficial in that it reduces the pathogen content of sludge sufficiently to permit broad agricultural use without compromising public health and safety. At the conclusion of this project, a number of sludge irradiation demonstration plants will have been constructed and placed in operation by municipalities across the country. In addition, a number of architect/engineer (A and E) firms will have participated in the design, licensing, construction and start-up of these plants. Those A and E firms will be capable of supporting additional sludge irradiation plants without further DOE involvement. Progress for the period October 1, 1980 through March 31, 1981 is discussed in some detail.

## 5602 Thermal Effects

35501 (ANL—80-115-Pt.3, pp 107-111) **Effects of constant and fluctuating temperatures on ectotherms.** Spigarelli, S.A.; Thommes, M.M.; Prepejchal, W.; Jensen, A. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

An experiment was designed to quantify the effects of observed thermal exposures on feeding , growth, lipid deposition, and pollutant uptake by brown trout in Lake Michigan. These factors were compared under three temperature treatments: (1) a simulation of the thermocyclic behavior of brown trout residing in thermal effluents during spring (mean = 12.5°C); (2) a constant temperature of 13°C, the optimum metabolic temperature for the species; and (3) ambient temperatures (mean = 7.7°C). Thus, the three treatments provided comparisons between two actual thermal regimes (thermocyclic and ambient) and between predicted (constant) are observed.

## 5603 Chemicals Metabolism And Toxicity

*REFER ALSO TO CITATION(S) 34277, 34278, 35412, 35426, 35429, 35457*

35502 **(ANL—80-115-Pt.3) Radiological and Environmental Research Division annual report, January-December 1980: ecology.** (Argonne National Lab., IL (USA)). Jul 1981. Contract W-31-109-ENG-38. 131p. NTIS, PC A07/MF A01. Order Number DE82000154.

Separate abstracts were prepared for individual reports of research programs. (ACR)

35503 (ANL—80-115-Pt.3, pp 1-5) **Effect on the productivity of field-grown soybeans by combinations of sulfur dioxide and nitrogen dioxide.** Irving, P.M.; Xerikos, P.B.; Miller, J.E. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

The effects of $SO_2$ and $NO_2$ in combination on a field-grown crop in the presence of ambient concentrations of ozone ($O_3$) were determined. The results suggest the yield decreases may have been caused by accelerated senescence. (ACR)

35504 (ANL—80-115-Pt.3, pp 6-10) **Effect of $H^+$, $SO_4^{2-}$, $NO_3^-$, and $NH_4^+$ concentrations and ratios in precipitation applied to greenhouse-grown soybeans.** Irving, P.M.; Sowinski, D.A. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

Because of the possibility that $SO_4$, $NO_3$, and $NH_4$, as well as $H^+$, may be important factors affecting plant response to acid rain, the effects on crop plants of precipitation simulants having various chemistries were examined. (ACR)

35505 (ANL—80-115-Pt.3, pp 11-14) **Impact of ozone on soybean yield.** Kress, L.W.; Miller, J.E. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

The impact of current and increased ozone ($O_3$) concentrations on crop yield in soybeans was examined. (ACR)

35506 (ANL—80-115-Pt.3, pp 15-18) **Variability of the yield response of field-grown soybean cultivars to $SO_2$.** Miller, J.E.; Smith, H.J.; Xerikos, P.B. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

Field studies were conducted on the effects of sulfur dioxide on the productivity of different soybean cultivars. (ACR)

35507 (ANL—80-115-Pt.3, pp 80-84) **Plankton microcosm research: response of natural phytoplankton communities to zinc toxicity, a preliminary report.** Hall, G.B. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

In 1976 Marshall and Mellinger developed an in situ method for toxicological studies on natural plankton communities using small-volume enclosures. Certain limitations of this procedure and interest by EPA's Office of Toxic Substances in developing plankton community microcosms for testing toxic substances, provided the stimulus for construction of a laboratory incubator designed to maintain natural plankton communities under simulated in situ conditions of temperature and photoperiod. The results reported here are part of a more detailed investigation of zinc toxicity to natural plankton communities isolated from Lake Michigan and maintained in the laboratory incubator at ambient lake temperatures (~ 3°C).

35508 (ANL—80-115-Pt.3, pp 85-88) **Use of a Coulter counter for seston analysis in plankton microcosm research.** Lei, C.; Marshall, J.S. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

A large incubator capable of holding 16 glass carboys (15.5 L capacity) has been constructed to allow the study of toxic effects of chemicals on natural plankton communities under simulated natural conditions of temperature, light intensity, photoperiod, and agitation in the laboratory. To follow seston dynamics in the incubator experiments (plankton microcosms), a rapid method of obtaining reliable data is needed. The Coulter counter (Coulter Electronics, Hialeah, Florida) was originally designed for routine counting and sizing of red blood cells, but it is now used extensively in various fields which need routine counting and sizing of particulate materials. A model TAII Coulter counter equipped with a population accessory was used to analyze the particle size distribution of seston in the second and third plankton microcosm studies.

35509 (ANL—80-115-Pt.3, pp 89-91) **Laboratory incubator for plankton microcosm research.** Prepejchal, W.; Marshall, J.S.; Hall, G.B.; Thommes, M.M. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

The need for a large laboratory incubator for toxicological studies on natural plankton communities arose from certain limitations of our in situ method. The in situ method involves some risk of loss of experimental enclosures (8 to 50-L glass or polyethylene carboys); also weather conditions and research vessel availability place restrictions on the frequency and time of sampling. Construction of an incubator designed to simulate in situ conditions of light, temperature, and mixing was a result of EPA's interest in developing plankton community microcosms for testing toxic substances.

35510 (ANL—80-115-Pt.3, pp 95-97) **Heterotrophy in a sediment-water microcosm.** Szczepanik-Van Leeuwen, P.A.; Penrose, W.R. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

Sediment-water microcosms were constructed from relatively undisturbed cores taken from Lake Michigan. These maintained superficial resemblances to the Lake Michigan benthic community for up to ten months. Experiments using $^{14}C$ tracers and toxic chemicals were conducted to examine the feasibility of using these for screening tests for newly-developed chemicals. (ACR)

35511 (ANL—80-115-Pt.3, pp 98-101) **Effects of zinc and cadmium on phytophankton primary productivity in southern Lake Michigan.** Parker, J.I.; Stanlaw, K.A.; Marshall, J.S. Jul 1981. NTIS, PC A07/MF A01. Order Number DE82000154.

In Radiological and Environmental Research Division annual report, January-December 1980: ecology.

Recent research has confirmed that wet atmospheric deposition over southern Lake Michigan contains concentrations of zinc and cadmium 2 to 3 orders of magnitude higher than does the lake water, and that additions of as little as 10% rainwater to lakewater samples suppressed phytoplankton primary productivity. These findings illustrated the potential for increasing zinc and cadmium concentrations in the lake water and prompted the development of a series of phytoplankton community-bioassay experiments to document the toxic effects of zinc and cadmium additions on phytoplankton primary productivity in Lake Michigan water samples.

35512 **(BNL—30055) Repair of chemical damage in mammalian cells.** Setlow, R.B. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 10p. (BIO—3767; CONF-810873—1). NTIS, PC A02/MF A01. Order Number DE81030823.

From NATO CNEN conference; Rome, Italy (24 Aug 1981).

The repair of chemical damage to DNA differs in many ways from the repair of radiation damage and its interpretation is often more complicated. For example, most chemicals of environmental concern do not react directly with cellular macromolecules but must first be activated to nucleophiles. Hence the dosimetry of chemicals is complicated and may vary markedly from tissue to tissue, organelle to organelle or from linker to the core region of DNA. The different reactivities between agents reacting directly and those that react indirectiy may give rise to products whose yields as a function of dose are completely different even though the products themselves may be the same. Nucleotide excision measurements of DNA repair are used extensively to detect agents that react with DNA and such measurements help identify DNA adducts that are dangerous. The chemical damages that mimic uv are repaired by nucleotide excision, and the chemicals are those that give rise to bulky adducts. Although the excision repair of bulky DNA adducts mimics the repair of uv damage in many ways, the identity of the repair pathways is a subject of controversy.

35513 **(CONF-810849—1) Sampling and chemical characterization of concentrated smokes.** Jenkins, R.A.; Gayle, T.M.; Wike, J.S. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1981. Contract W-7405-ENG-26. 32p. NTIS, PC A03/MF A01. Order Number DE81028564.

From Boulder conference on sampling and analysis of toxic materials in the atmosphere; Boulder, CO, USA (2 Aug 1981).

Concepts and procedures for the sampling and chemical characterization of concentrated smokes being bioassayed via inhalation exposure are presented. (ACR)

35514 **(CONF-810959—1) Chemicals identified in human biological media.** Cone, M.V.; Stroup, C. (Oak Ridge National Lab., TN (USA); Environmental Protection Agency, Washington, DC (USA)). 1981. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01. Order Number DE81030813.

From 2. EPA/NCI annual collaborative workshop on environmental and occupational cancer studies; Rockville, MD, USA (9 Sep 1981).

Sources of data for Chemicals Identified in Human Biological Media are from the world literature, retrospective to 1974. Information from approximately 1500 documents is in the data base at the present time. The data base contains information on 750 chemicals. Approximately 250 of these were added since this time last year. Approximately 10% of the total documents in the file concerned pesticides; 30%, drugs; and 40%, metals. The remaining 20% were about other substances, including industrial chemicals and organics which are of interest to NCI and EPA.

35515 **(CONF-810966—1) Possible mechanism for chemical induction of chromosome aberrations in male meiotic and postmeiotic germ cells of mice.** Generoso, W.M. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01. Order Number DE81031999.

From 4. international symposium of the Radiation Biology Center; Kyoto, Japan (28 Sep 1981).

The mechanisms by which chemically induced lesions in the chromosomes of mammalian germ cells are actually converted to aberrations and transmitted to progeny are very complex and little understood. An attempt is made to explain how dominant-lethal mutations and heritable translocations are produced from chemical treatment of meiotic and postmeiotic germ cells of male mice.

35516 **(CONF-810967—1) Acid rain and forest productivity.** Johnson, D.W. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 37p. NTIS, PC A03/MF A01. Order Number DE81030916.

From IUFRO meeting; Kyoto, Japan (Sep 1981).

Acid rain can cause increases or decreases in forest productivity depending on site nutrient status and the duration and rate of inputs. Some acid irrigation studies have shown short-term growth increases due to increased N availability, yet long-term growth reductions remain theoretically possible because of cation depletion and toxic aluminum accumulations in soils. It cannot be overemphasized that the problem of assessing acid rain effects on forest productivity is one of quantification. Generalization about acid rain effects without reference to the amount of acidic input and site nutrient conditions are hazardous.

35517 **(CONF-810973—1) Structure activity studies with n-nitrosamines using Salmonella typhimurium and escherichia coli.** Rao, T.K.; Epler, J.L.; Lijinsky, W.;. (Oak Ridge National Lab., TN (USA); Frederick Cancer Research Center, MO (USA)). 1981. Contract W-7405-ENG-26. 12p. NTIS, PC A02/MF A01. Order Number DE81030808.

From 7. international meeting on N-nitroso compounds: occurrence and biological effects; Tokyo, Japan (28 Sep 1981).

Cyclic nitrosamines exhibited a relationship between their mutagenic activity and molecular ring size. They exhibited a closer relationship between their mutagenic and carcinogenic properties. Substitution with alkyl or hydroxy groups did not affect the biological activity. Substitution in the $\alpha$-positions to the N-nitroso group eliminated both mutagenic and carcinogenic properties. Halogen substitution enhanced carcinogenic activity and had slight if any effect on mutagenicity. Carboxy substitution eliminated the biological activity. Aliphatic nitrosamines failed to show any relationship between mutagenesis and carcinogenesis. Use of E. coli assay not only substantiated Salmonella results; it was also capable of identifying certain carcinogens (nitrosopyrroline, 3,4-dibromonitrosopyrrolidine and methylethylnitrosamine) as mutagens that were missed in the Salmonella assay.

35518 **(DOE/EV/05888—4) Impact of energy-related pollutants on chromosome structure. Progress report, January 1, 1981-December 31, 1981.** Rill, R.L. (Florida State Univ., Tallahassee (USA). Inst. of Molecular Biophysics). 1981. Contract AS05-78EV05888. 11p. NTIS, PC A02/MF A01. Order Number DE82000153.

Products of reactions of deoxyribonucleosides with diethylsulfate and ethyl methanesulfonate in neutral aqueous solution and in DMSO, and with ethyl iodide in DMSO, were separated and quantitated by reverse phase PHLC. Aqueous reactions yielded small, but significant, amounts of nucleosides modified at exocyclic positions. Several unidentified derivatives not previously reported

were found. A method for resolving all known ethylated deoxyribonucleotides was developed. The covalent coupling of ethidium monoazide to DNA alone and DNA in chromatin was examined. Covalently bound ethidium preferentially bound to DNA recovered in subnucleosomes. The amount of covalently bound ethidium recovered in mononucleosomes decreased with increasing nuclease digestion, suggesting that nucleosomes most susceptible to nuclease attack preferentially bind ethidium. Covalently bound ethidium weakens the glycosidic bond so that the DNA chain can be cleaved specifically at ethidium-bound sites. This will permit precise definition of ethidium binding sites in nucleosomes. High field, natural abundance carbon-13 NMR spectra and NOE data were obtained for nucleosome core length DNA complexed with various concentrations of mercury. Mercury binding caused no significant changes in resonance linewidths or NOE's. This suggests that mercury ions primarily form interstrand crosslinks between base pairs without affecting the chain motional dynamics.

35519 **(DOE/TIC—11494) Study of protein modifications induced by phorbol ester tumor promoters in mouse skin.** Nelson, K.G. (Oak Ridge Associated Universities, Inc., TN (USA); Tennessee Univ., Knoxville (USA)). Aug 1981. Contract AC05-76OR00033. 104p. NTIS, PC A06/MF A01. Order Number DE81031985.

Thesis. Submitted to the Univ. of Tennessee, Knoxville, TN.

The purpose of this study was to determine if the phorbol ester tumor promoter 12-0-tetradecanoylphorbol-13-acetate (TPA) induced any specific changes in mouse epidermal proteins using the high resolution technique of two-dimensional electrophoresis. To accomplish this goal of determining the specificity and possibly the stage in promotion with which these protein changes were associated, epidermal proteins were analyzed (1) after treatment of adult mouse epidermis with several weakly promoting hyperplasiogenic agents, (2) following treatment with TPA in combination with various inhibitors of tumor promotion, (3) in basal kerotinocytes isolated from adult epidermis following treatment with TPA or several weakly promoting agents, and (4) during an initiation-promotion experiment. Evidence was found which indicated that the potent tumor promoter TPA as well as the weakly promoting hyperplasiogenic agents, mezerein, ethylphenylpropiolate (EPP), and mechanical abrasion, induced similar modifications of epidermal proteins, particularly among the keratins. These keratin modifications progressed with time following treatment resulting in a keratin pattern which resembled that of newborn epidermis.

35520 **(EPRI—205A-Pt.2-App.) Effects of sulfur oxides on the lung: an analytic base. Part II. Appendix to RP 205.** Hausknecht, D.F.; Ziskind, R.A. (Science Applications, Inc., El Segundo, CA (USA)). Sep 1975. 144p. NTIS, PC A07/MF A01. Order Number DE82900024.

The workshop panel was comprised of experts in sulfur oxide toxicology, pulmonary medicine, mathematical modeling of the respiratory system, including detailed morphometry, and cytology. Each of the reviewers was provided a copy of the Report in draft form several weeks before the workshop which was conducted November 25 and 25, 1974 at EPRI Headquarters in Palo Alto. The reviewers were requested to comment on the validity and adequacy of the approach described in achieving the goals stated in the Report. The written reviews provided by the workshop participants are reproduced.

35521 **(EPRI-EA—1491) Review of open literature on effects of chlorine on aquatic organisms.** Opresko, D.M. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 320p. NTIS, PC A14/MF A01. Order Number DE82000097.

The pre-1980 open literature on the chemistry and biological effects of chlorine in marine, freshwater, and estuarine systems is reviewed with special emphasis placed on the potential impacts of power plant chlorination practices. Information is provided on aqueous chlorine chemistry including the types and relative concentrations of residual oxidants formed under varying environmental conditions; the stability, persistence, and reactivity of these oxidants; and their potential for forming halogenated organic compounds. Analytical methods for differentiating and measuring chlorine-produced residual oxidants are discussed in a separate section. Information on biological effects, derived mainly from the results of laboratory bioassays, consists primarily of acute toxicity data, but also included are discussions of biological and environmental factors affecting species' tolerance levels; sublethal effects on reproduction, growth, behavior, and physiological processes such as respiration and osmoregulation; and possible mechanisms of oxidant toxicity at the cellular or biochemical level. The final chapter considers the relative efficiency and potential environmental impact of alternative chemical and physical methods for controlling biofouling in power plant cooling systems.

35522 **(ORNL/EIS—164) Information Center Complex publications and presentations, 1971-1980.** Gill, A.B.; Hawthorne, S.W. (Oak Ridge National Lab., TN (USA)). Aug 1981. Contract W-7405-ENG-26. 180p. NTIS, PC A09/MF A01. Order Number DE82000521.

This indexed bibliography lists publications and presentations of the Information Center Complex, Information Division, Oak Ridge National Laboratory, from 1971 through 1980. The 659 entries cover such topics as toxicology, air and water pollution, management and transportation of hazardous wastes, energy resources and conservation, and information science. Publications range in length from 1 page to 3502 pages and include topical reports, books, journal articles, fact sheets, and newsletters. Author, title, and group indexes are provided. Annual updates are planned.

35523 **Elemental composition of saltcedar (Tamarix chinensis) impacted by effluents from a coal-fired power plant.** Dreesen, D.R.; Wangen, L.E. (Los Alamos National Lab., NM). Contract W-7405-ENG-36. *Journal of Environmental Quality ;* **10**: No. 3, 410-416(Sep 1981).

The riparian shrub, saltcedar (Tamarix chinensis), was sampled in channels receiving effluents from a coal-fired power plant. Sources of these effluents included decant from coal ash/scrubber sludge disposal ponds, seepage from these ponds, and blowdown from the cooling lake. In addition, saltcedar was collected from an ephemeral stream channel both upstream and downstream from the input of these effluents. Green-leaf and branch material was analyzed for B, Cu, K, Mg, Na, Li, Sr, Ti, Al, Si, Fe, Mn, P, V, Mo, and Zn in both washed and unwashed samples. The goals of this study were to determine if elevated concentrations of trace, minor, and major elements were present in this species growing adjacent to effluent streams and whether these elements were present in this species growing adjacent to effluent streams and whether these elements were present as surficial contaminants. Washed saltcedar samples were enriched in Mo, B, Cu, K, Mg, Li, Mn, P, and Zn for one or more effluent channel locations. Unwashed saltcedar samples were enriched in soil or coal ash matrix elements (Si, Al, Ti, Ba, and Fe). These elements appeared to be present in coal ash particles deposited on the plant surfaces. More than 80% of these surficial contaminants were removed by washing. In addition to these elements, unwashed saltcedar samples from effluent channels were enriched in Mo, B, Cu, K, Mg, Li, Mn, P, and Zn compared with upstream values. The elements Ca, Na, and Sr were depleted in this species growing in some effluent channels. The results of this study indicated that B is the coal ash contaminant most likely to be absorbed and translocated by plants exposed to such coal-fired power plant effluents.

## 5604 Other Environmental Pollutant Effects

*REFER ALSO TO CITATION(S) 34695*

35524 **(PNL-SA—9425) Effects of magnetic field exposure in fertilization success of rainbow trout, Salmo gairdneri.** Strand, J.A.; Abernethy, C.S.; Skalski, J.R.; Genoway, R.G. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1981. Contract AC06-76RL01830. 14p. (CONF-810875—1). NTIS, PC A02/MF A01. Order Number DE81030101.

From 3. annual meeting of the Bioelectromagnetic Society; Washington, DC, USA (10 Aug 1981).

Initial studies conducted at this laboratory (Strand et al., 1980) suggested that fertility of trout eggs could be affected by magnetic fields of 1T. Additional studies were performed to confirm these results and to examine the relative susceptibility of egg

and sperm to magnetic fields. Preliminary results and their interpretation are presented here.

# 57 HEALTH AND SAFETY

*REFER ALSO TO CITATION(S) 34435, 35426, 35752*

35525 **(CONF-810905—7) Determination of the statistical distributions of model parameters for probabilistic risk assessment.** Fields, D.E.; Glandon, S.R. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01. Order Number DE82000147.

From ANS/ENS topical meeting on probabilistic risk assessment; Post Chester, NY, USA (20 Sep 1981).

Successful probabilistic risk assessment depends heavily on knowledge of the distribution of model parameters we have developed. The TERPED computer code is a versatile methodology for determining with what confidence a parameter set may be considered to have a normal or lognormal frequency distribution. Several measures of central tendency are computed. Other options include computation of the chi-square statistic, the Kolmogorov-Smirnov non-parametric statistic, and Pearson's correlation coefficient. Cumulative probability plots are produced either in high resolution (pen-and-ink or film) or in printerplot form.

35526 **(DOE/MA—0035) Federal employee occupational safety and health briefing for management officials.** (USDOE Assistant Secretary for Management and Administration, Washington, DC). Sep 1981. 57p. NTIS, PC A03/MF A01. Order Number DE82000706.

The US Department of Energy is presenting a one-hour executive briefing on the Federal Employee Occupational Safety and Health Program. This comprehensive orientation program presents an overview of information and resources for senior executives regarding their responsiblities in managing the Federal Employee Safety and Health Program, thus incorporating safety and health as an integral part of the management function. The materials and information presented at the briefing are presented in this report.

35527 **(SAND—81-0643) Guidance for implementing an environmental, safety and health assurance program. Volume 12. Model guidelines for line organization environmental, safety and health inspection and monitoring activities.** Ellingson, A.C. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1981. Contract AC04-76DP00789. 44p. NTIS, PC A03/MF A01. Order Number DE81030991.

This is 1 of 15 documents designed to illustrate how an Environmental, Safety and Health (ES and H) Assurance Program may be implemented. The generic definition of ES and H Assurance Programs is given in a companion document entitled An Environmental, Safety and Health Assurance Program Standard. The Standard specifies that the operational level of an institution must have internal control and assurance functions, and this document provides guidance for the inspection and monitoring activities which are a very basic part of such functions.

35528 **(SAND—81-0644) Guidance for implementing an environmental, safety and health assurance program. Volume 13. Model guidelines for line organization environmental, safety and health meetings.** Ellingson, A.C.; Trauth, C.A. Jr.; Jercinovic, L.M. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1981. Contract AC04-76DP00789. 38p. NTIS, PC A03/MF A01. Order Number DE81030980.

This is 1 of 15 documents designed to illustrate how an Environmental, Safety and Health (ES and H) Assurance Program may be implemented. The generic definition of ES and H Assurance Programs is given in a companion document entitled An Environmental, Safety and Health Assurance Program Standard. The Standard stresses participation by and feedback from employees in ES and H matters, and this document shows how ES and H meetings may be used as a framework for employee involvement in the ES and H program. Such involvement is essential for defining the acceptability of ES and H controls from an employee's perspective.

# 58 GEOSCIENCES

## 5801 Geology And Hydrology

*REFER ALSO TO CITATION(S) 34250*

## 5802 Geophysics

*REFER ALSO TO CITATION(S) 34327, 34341*

35529 **(DOE/ER/10769—T1) Influence of out-of-plane surface properties on time logs.** Cohen, J.K.; Bleistein, N. (Denver Univ., CO (USA). Dept. of Mathematics). 29 Jul 1981. Contract AC02-80ER10769. 39p. NTIS, PC A03/MF A01. Order Number DE81030971.

Some effects of out-of-plane surface properties are demonstrated by both analytical and numerical means. In particular, out of plane curvature effects are discussed along with possible pitfalls of traditional two dimensional interpretation of the seismic events seen on a timelog.

## 5803 Mineralogy, Petrology, And Rock Mechanics

*REFER ALSO TO CITATION(S) 34293, 34389*

35530 **(SAND—81-1232) Analysis of data from line-source thermal-conductivity measurements taken in situ in dome salt at the Avery Island Mine.** McVey, D.F. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1981. Contract AC04-76DP00789. 79p. NTIS, PC A05/MF A01. Order Number DE82000517.

In-situ thermal conductivity was measured in dome salt at the Avery Island Mine by use of a line source thermal conductivity probe. The thermal conductivity was determined to be 5.8 W/m-K at about 26°C and 5.6 W/m-K at about 31°C. Because the influence of contact resistance and two-dimensional effects prevented the temperature rise from attaining the log-time linear asymptote classically used to analyze line source probe data, a new data reduction procedure using parameter estimation techniques was developed. The procedure obtains a least-squares-best-fit of a classic line source integral solution to the non-linear early time temperature data. In the fit, contact resistance and thermal conductivity are free parameters. The technique removes many of the classic assumptions that restrict the usefulness of line source probes for in situ measurements.

## 5804 Geochemistry

*REFER ALSO TO CITATION(S) 34319*

35531 **(GJBX—309-81) Hydrogeochemical and stream sediment reconnaissance basic data for Ekalaka Quadrangle, Montana.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Jul 1981. Contract W-7405-ENG-26. 141p. (K/UR—353). NTIS, PCE 06/MF A01. Order Number DE82000250.

Includes 1 sheet of 48x reduction microfiche.

Field and laboratory data are presented for 397 water samples and 746 sediment samples from the Ekalaka Quadrangle, Montana. Uranium values have been reported by Los Alamos National Laboratory in Report GJBX-55(78). The samples were collected by Los Alamos National Laboratory; laboratory analysis and data reporting were performed by the Uranium Resource Evaluation Project at Oak Ridge, Tennessee.

35532 **(PNL-SA—9137) Chemical migration by contact metamorphism between granite and silt/carbonate system.** Laul, J.C.; Papike, J.J. (Pacific Northwest Lab., Richland, WA (USA); State Univ. of New York, Stony Brook (USA). Dept. of Earth and Space Sciences). 1981. Contract AC06-76RL01830. 12p. (CONF-810722—13; IAEA-SM—257/59p). NTIS, PC A02/MF A01. Order Number DE81030087.

From International symposium on migration in the terrestrial environment of long-lived radionuclides from the nuclear fuel cycle; Knoxville, TN, USA (27 Jul 1981).

Comparison of trace element signatures between the metamorphosed and unmetamorphosed samples from granite-silt/carbonate system suggests that some elements do migrate during contact metamorphism. The relative degree of migration varies depending on the element. The evidence of chemical migration in silt and carbonate is convincing on a several-meter scale.

# 64 PHYSICS RESEARCH

## 6401 Astrophysics And Cosmology

35533 **Fragmentation in rotating isothermal protostellar clouds.** Bodenheimer, P. (California Univ., Santa Cruz (USA). Lick Observatory); Tohline, J.E. (Los Alamos Scientific Lab., NM (USA)); Black, D.C. (National Aeronautics and Space Administration, Moffett Field, CA (USA). Space Science Div.). *Space Science Reviews ;* **27**: No. 3/4, 247-253(Nov-Dec 1980).

In this paper we report briefly the results of an extensive set of 3-D hydrodynamic calculations that have been performed during the past two and one-half years to investigate the susceptibility of rotating clouds to gravitational fragmentation. Because of the immensity of parameter space and the expense of computations, we have chosen to restrict this investigation to strictly isothermal collapse sequences.

35534 **(DOE/ER/10719—T1) Research in nuclear astrophysics: stellar collapse and supernovae. Progress report, December 1, 1981-November 30, 1984.** Mazurek, T.J.; Lattimer, J.M. (State Univ. of New York, Albany (USA). Research Foundation; State Univ. of New York, Stony Brook (USA)). 1981. Contract AC02-80ER10719. 40p. NTIS, PC A03/MF A01. Order Number DE81030041.

The implications of nuclear theory for the final collapse of massive stars will be examined. Development of an appropriate nuclear equation of state and its implementation in hydrodynamic studies will be continued. The influence of nuclear dissociation and neutrino emission on the formation and propagation of shocks will be studied. The long term evolution of collapsed stellar cores after the initial hydrodynamic bounce will be investigated. Neutrino production and emission in all phases will be derived. Potential effects of pion condensation and neutrino instabilities will be explored.

35535 **(UCRL—86611) Thermonuclear model for $\gamma$-ray bursts.** Woosley, S.E. (California Univ., Santa Cruz (USA). Lick Observatory; Lawrence Livermore National Lab., CA (USA)). 26 Aug 1981. Contract W-7405-ENG-48. 23p. (CONF-810871—2). NTIS, PC A02/MF A01. Order Number DE81030835.

From Workshop on gamma ray transients and related astrophysical phenomena; La Jolla, CA, USA (5 Aug 1981).

The evolution of magnetized neutron stars with field strengths of $\sim 10^{12}$ gauss that are accreting mass onto kilometer-sized polar regions at a rate of $\sim {}^{13}M_{\odot}yr^{-1}$ is examined. Based on the results of one-dimensional calculations, one finds that stable hydrogen burning, mediated by the hot CNO-cycle, will lead to a critical helium mass in the range $10^{20}$ to $10^{22}$ g $km^{-2}$. Owing to the extreme degeneracy of the electron gas providing pressure support, helium burning occurs as a violent thermonuclear runaway which may propagate either as a convective deflagration (Type I burst) or as a detonation wave (Type II burst). Complete combustion of helium into $^{56}$Ni releases from $10^{38}$ to $10^{40}$ erg $km^{-2}$ and pushes hot plasma with $\beta > 1$ above the surface of the neutron star. Rapid expansion of the plasma channels a substantial fraction of the explosion energy into magnetic field stress. Spectral properties are expected to be complex with emission from both thermal and non-thermal processes. The hard $\gamma$-outburst of several seconds softens as the event proceeds and is followed by a period, typically of several minutes duration, of softer x-ray emission as the subsurface ashes of the thermonuclear explosion cool. In this model, most $\gamma$-ray bursts currently being observed are located at a distance of several hundred parsecs and should recur on a timescale of months to centuries with convective deflagrations (Type I bursts) being the more common variety. An explanation for Jacobson-like transients is also offered.

35536 **Rayleigh-taylor overturn in supernova core collapse.** Smarr, L.; Wilson, J.R.; Barton, R.T.; Bowers, R.L. (Department of Astronomy, University of Illinois). W-7405-ENG-48. *Astrophysical Journal ;* **246**: No. 2, 515-525(1 Jun 1981).

We perform a two dimensional radiation diffusion coupled to hydrodynamics calculation of nonspherical instabilities in the collapsed core from a massive star. The core properties are taken from a one dimensional collapse calculated with detailed microphysics and neutrino transport. The shocked outer core [0.7 M/sub sun/< or ≈M(r)1.3 M/sub sun/] is found to contain three subregions. The innermost is doubly diffusive ("neutron fingers") unstable, the center subregion is dynamically unstable, and the outermost is stable. We find that the unstable part of the outer core overturns in ~5 ms without disturbing the inner unshocked core of M< or ≈0.7 M/sub sun/. This overturned outer core expands as a piston, creating an outgoing shock wave which may help power envelope ejection. This outer core overturn would seem to be a generic feature of core collapse which has heretofore been neglected.

35537 **Wave-electron interactions in the high speed solar wind.** Schwartz, S.J.; Feldman, W.C.; Gary, S.P. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Geophysical Research ;* **86**: No. A6, 4574-4578(1 Jun 1981).

We investigate the role of plasma wave-particle interactions in modifying the electron velocity distributions of the high speed solar wind. Both electrostatic and electromagnetic fluctuations are considered. We find that interactions between thermal electrons and a small fraction of the observed wave spectrum provide a momentum exchange rate strong enough to compete with Coulomb collisions.

35538 **CP violation and the development of cosmological baryon asymmetry.** Senjanovic, G. (Brookhaven National Laboratory, Upton, New York 11973). *AIP (American Institute of Physics) Conference Proceedings ;* **72**: No. 1, 192-223(May 1981). (CONF-801244—).

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

A discussion of the origin of the observed matter-antimatter asymmetry of the universe is presented in the context of the standard cosmological model. Except in the case of the minimal SU(5) theory, it is possible that grandunified theories predict the right order of magnitude for the ratio of baryon to photon number. The question of CP violation is addressed in detail and it is shown that, tied up with symmetry nonrestorationat high temperature, the soft CP violation does remain at T≅$10^{15}$ GeV as to lead to the creation of baryon asymmetry in the very early universe.

35539 **Big bang baryosynthesis and grand unification.** Turner, M.S. (Astronomy and Astrophysics Center, The University of Chicago, Chicago, Illinois 60637). AC02-80ER-10773. *AIP (American Institute of Physics) Conference Proceedings ;* **72**: No. 1, 224-243(May 1981). (CONF-801244—).

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

The universe possesses an overt matter-antimatter asymmetry, quantified as the baryon-to-specific entropy ratio, kn/sub B// s≅10/sup -11plus-or-minus1/. An attractive explanation is that this ratio evolved dynamically due to B, C, and CP violating interactions during a period of non-equilibrium in the GUP epoch (t~$10^{-35}$s). The out-of-equilibrium decay scenario is reviewed and detailed numerical results are discussed. A model for the requisite CP violation within the minimal SU(5) theory (one 5 and one 24 representations of Higgs) is presented. Baryosynthesis is discussed in detail for a generic superheavy boson, and a constraint on low energy unification schemes is obtained.

**35540 Structure of the solar chromosphere. III. Models of the EUV brightness components of the quiet sun.** Vernazza, J.E.; Avrett, E.H.; Loeser, R. (Harvard-Smithsonian Center for Astrophysics). *Astrophysical Journal, Supplement Series ;* **45**: No. 4, 635-725(Apr 1981).

Skylab observations of the quiet Sun in the EUV wavelength range 40—140 nm show the inhomogeneous structure of the chromosphere. We use these observations to determine separate chromospheric models for six observed brightness components, ranging from a dark cell center to a very bright network element. In each case we solve the non—LTE radiative transfer, statistical equilibrium, and hydrostatic equilibrium equations to determine the temperature-density stratification that produces a calculated spectrum in best agreement with the observed one. Our hydrogen calculations are carried out with an atomic model consisting of eight explicit levels and supplementary levels 9—12. We account for the effects of partial frequency redistribution in the formation of the hydrogen Lα and Lβ lines and the resonance lines of Ca II and Mg II. To obtain the results shown here we carry out non—LTE calculations for H, $H^-$, C, Si, Fe, Mg, Al, He, He II, Ca II, Mg II, and several other atoms and ions. We obtain good agreement between observed and calculated intensities in the Lα and Lβ lines, the Lyman continuum, and other continua in the 40—140 nm range. We base our temperature minimum determination on continuum observations in the 135—168 nm range but obtain minimum temperature values which are lower than implied by the Ca II and Mg II lines and recent microwave observations. In the upper chromosphere our models are in good agreement with those obtained by Basri et al. from a study of the observed Lα line. However, the temperature reduction in the low chromosphere proposed by Basri et al. is a consequence of their assumption of LTE for the carbon continuum which causes a spurious enhancement of the computed intensity in the Lα wings. Finally, we compute the net radiative cooling rates for the atoms and ions listed above.

**35541 Bi-directional streaming of solar wind electrons >80 eV: ISEE evidence for a closed-field structure within the driver gas of an interplanetary shock.** Bame, S.J.; Asbridge, J.R.; Feldman, W.C.; Gosling, J.T.; Zwickl, R.D. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Geophysical Research Letters ;* **8**: No. 2, 173-176(Feb 1981).

In near time coincidence with the arrival of helium enriched plasma driving the shock wave disturbance of November 12—13, 1978, strong bi-directional streaming of solar wind electrons $> \sim 80$ eV was observed with Los Alamos instrumentation on ISEE 3. The streaming persisted for many hours simultaneously parallel and antiparallel to the interplanetary magnetic field which was directed roughly perpendicular to the sun satellite line. The example of bidirectional streaming clearly cannot be explained by field line connection to either the earth's bow shock or the outward propagating interplanetary shock which passed ISEE 3 $\sim$16 hours earlier. The event is best explained if the local interplanetary field was a part of either a magnetic bottle rooted at the sun or a disconnected loop propagating outward.

**35542 Solar type protostars.** Winkler, K.H.A. (Los Alamos Scientific Lab., NM (USA); California Univ., Livermore (USA). Lawrence Livermore National Lab.); Newman, M.J. (Los Alamos Scientific Lab., NM (USA)). *Space Science Reviews ;* **27**: No. 3/4, 261-266(Nov-Dec 1980).

The formation of a 1 Msub(sun) protostar in spherical symmetry has been followed in time dependent hydrodynamics with a detailed description of the equation of state and a careful treatment of radiative transport. The comparison of the dynamic evolution with observation is made in terms of the Hertzprung-Russell diagram. It is found that the evolution following from Larson's initial condition produces quantitatively and qualitatively better agreement than that following from the initial condition of Hayashi, including the first appearance of the object as an infrared source. Of particular importance for a correct physical understanding of the formation process is an adequate description of the accretion shock. Pressure ionization and electron degeneracy effects are of increasing importance for the internal structure of lower mass objects.

**35543 Numerical study of the fission hypothesis for rotating polytropes.** Durisen, R.H.; Tohline, J.E. (Los Alamos Scientific Lab., NM (USA)). *Space Science Reviews ;* **27**: No. 3/4, 267-273(Nov-Dec 1980).

Our results show that n = 3/2 and n = 1/2 polytropes are dynamically unstable to non-axisymmetric perturbations if t approx. > 0.30, in rough agreement with linear theory. Instead of fission as the direct end product of dynamic instability in rapidly rotating, centrally condensed stars, it appears that a rapidly rotating star can, through gravitational torques, eject some high angular momentum material in its equatorial plane and settle down into a dynamically stable (lower t) configuration.

**35544 Two-dimensional radiation-hydrodynamics calculations of the formation of O-B associations in dense molecular clouds.** Klein, R.I. (California Univ., Berkeley (USA). Dept. of Astronomy); Sandford, M.T. II; Whitaker, R.W. (Los Alamos Scientific Lab., NM (USA)). *Space Science Reviews ;* **27**: No. 3/4, 275-282(Nov-Dec 1980).

Two-dimensional calculations of ionization-shockwave propagation into a curved molecular cloud are presented. Density enhancement occurs due to the combined effects of cloud curvature and radiation flow. The star formation process is expected to be enhanced near the edges of irregularly shaped molecular clouds.

**35545 Numerical simulation of the solar granulation.** Cloutman, L.D. (Los Alamos Scientific Lab., NM (USA)). *Space Science Reviews ;* **27**: No. 3/4, 293-299(Nov-Dec 1980).

The solar granulation has been simulated by numerical solution of the multidimensional, time-dependent, nonlinear Navier-Stokes equations applied to the solar atmosphere. Granules may be explained as buoyantly rising bubbles created at the level where T = 8000 K, and which have collapsed into vortex rings. The calculation is in quantitative agreement with observations and has a number of implications for solar physics and convection theory.

**35546 Linear and nonlinear pulsations of β Cephei stars.** Cox, A.N.; Hodson, S.W. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). *Space Science Reviews ;* **27**: No. 3/4, 323-327(Nov-Dec 1980).

The best known β Cephei variable is a α Virginis (Spica) because it is a binary star (P = 4.01 days) and has an interferometer measurement of its angular diameter. In this study to see if the pulsations can be caused by mixing of hydrogen and helium in the semiconvective zone, the parameters we take are 11.5 Msub(sun), 26,300 K, 6.5 x $10^{37}$ erg/s with an envelope composition of Y = 0.28, Z = 0.02. These data agree within the errors of observations as reported recently by Odell (1980), and the theoretical radial fundamental mode period of 0.171 day compares well with the single observed pulsation period of 0.174 day.

**35547 Light and velocity curve bumps for BW Vulpeculae.** Pesnell, W.D. (Florida Univ., Gainesville (USA)); Cox, A.N. (Los Alamos Scientific Lab., NM (USA)). *Space Science Reviews ;* **27**: No. 3/4, 337-343(Nov-Dec 1980).

BW Vulpeculae (HD 199140) is a well known Beta Cephei star, with several unusual characteristics. It possesses the largest amplitude in both light and radial velocity variations, of any star in this classification. The most outstanding feature of the observations is a standstill or bump, on the light curve, accompanied by doubled lines in the radial velocity observations. In this paper, we have attempted to explain these phenomena with two different models. Firstly, the resonance mechanism, from Simon and Schmidt, and secondly, a non-linear calculation.

## 6402 Atmospheric Physics

**35548 Microinstabilities upstream of the earth's bow shock: A brief review.** Gary, S.P. (Physics Division, University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Geophysical Research ;* **86**: No. A6, 4331-4336(1 Jun 1981).

This is a brief review of short wavelength fluctuations and their associated phenomena upstream of the earth's bow shock. Sources of free energy, the most unlikely instabilities, and the associated nonlinear consequences that may be observed are discussed.

35549 **Characteristics of reflected and diffuse ions upstream from the earth's bow shock.** Paschmann, G.; Sckopke, N.; Papamastorakis, I.; Asbridge, J.R.; Bame, S.J.; Gosling, J.T. (Max-Planck-Institut fuer extraterrestrische Physik, 8046 Garching, West Germany). *Journal of Geophysical Research ;* **86**: No. A6, 4355-4364(1 Jun 1981).

The distinction between two types of upstream ion populations has been made on the basis of pronounced differences in their distribution functions. The 'reflected' ions represent a fast beam with temperatures typically 1 to 5 times $10^6$ K and speeds up to five times the solar wind speed. An important feature of the reflected ion distributions in their strong temperature anisotropy, with T/ sub perpendicular/ exceeding T/sub parallel/ by a factor of two to three. In contrast, the 'diffuse' ions occupy a much larger region of phase space, both in energy and angle; their distribution function generally has the form roughly of a circular ridge in 2 dimensions and a spherical shell in 3 dimensions. Accordingly, their temperature is much larger (> or $\approx 10^7$ K), and their bulk speed typically is smaller than the solar wind speed. Both ion populations have densities of the order of 0.1 $cm^{-3}$. At times transitions between the two extremes, represented by the reflected and diffuse ion populations, are observed. These 'intermediate' distributions are cresent shaped, with the center of curvature near the solar wind velocity. This property suggests that the intermediate distributions result from pitch angle scattering of the reflected beams in the solar wind frame and supports the idea that the reflected ions are the origin of the diffuse ions. At times the diffuse ion distributions exhibit considerable structure and rapid temporal variations. Reflected and diffuse ions can also be distinguished by their occurrence as a function of the angle $\theta$ between the local shock normal and the interplanetary magnetic field. Whereas the diffuse ions occur predominantly for small $\theta$, the reflected ions are observed most frequently for $\theta >$ or $\approx 45^0$.

35550 **High time resolution study of interplanetary parameter correlations with AE.** Baker, D.N.; Hones, E.W. Jr.; Payne, J.B.; Feldman, W.C. (University of California, Los Alamos Scientific Laboratory, Los Alamos New Mexico 87545). *Geophysical Research Letters ;* **8**: No. 2, 179-182(Feb 1981).

Using the earth-orbiting spacecraft IMP-8, we have performed a high time-resolution (2.5-min) study of the linear cross-correlations of a quantitative indicator of magnetospheric substorm activity, the auroral electrojet (AE) index, with several interplanetary (IP) parameters. The present study includes all available satellite data (from an eight-month period) rather than selecting a small number of substorm events, or a relatively small number of chosen days. Prior published studies have suggested that geomagnetic activity is related to a variety of solar wind parameters: solar wind speed (V); north-south magnetic field component (B/sub z/); total interplanetary magnetic field (IMF) strength (B); and various combinations of these parameters. Very recently, a new parameter, $\epsilon (= VB^2 \sin^4(\theta/2) l_0^2)$, has been suggested as a superior predictor of substorm activity. The other major preferred correlator with geomagnetic activity is $VB_s$, where $B_s$ is the southward (B/sub z/<0) component of the IMF. Substantial discussion has ensued as to which parameters is the "best" predictor of substorm activity. The present non-selective, high-resolution analysis reveals that $VB_s$ generally reaches a higher peak correlation than $\epsilon$ (0.6 vs 0.54). Both parameters reach a peak correlation at the same lag time (with AE lagging the IP parameters by ~40 min.), but $VB_s$ also appears to have a preferable qualitative lag profile shape for AE prediction purposes.

## 6403 Atomic, Molecular, And Chemical Physics

*REFER ALSO TO CITATION(S) 35665*

35551 **(CONF-810958—1) Electron-impact excitation of ions.** Crandall, D.H. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 52p. NTIS, PC A04/MF A01. Order Number DE81030806.

From NATO advanced study summer institute; Baddeck, Nova Scotia, Canada (13 Sep 1981).

A review of electron-ion beam experiments is given. Techniques, difficulties, and present trends in this area are discussed. Measured cross sections are compared with theoretical results and the current level of agreement is assessed. 74 references. (WHK)

35552 **Coherent pumping of microwave transitions between highly excited states.** Bottcher, C.; Feuillade, C. (Oak Ridge National Lab., TN (USA)). *Chemical Physics (Amsterdam) ;* **54**: No. 2, 227-240(1 Jan 1981).

The problem of describing the absorption of microwave radiation between pairs of multi-degenerate molecular rotational energy levels, and collisional relaxation of the irradiated transitions, is approached generally by deriving a system of coupled tensorial Bloch equations. These are solved directly for the case of highly excited states, where a number of simplifying assumptions are valid.

35553 **(LBL—13156) Collisions of fast multicharged ions in gas targets: charge transfer and ionization.** Schlachter, A.S. (Lawrence Berkeley Lab., CA (USA)). May 1981. Contract W-7405-ENG-48. 18p. (CONF-8105113—1). NTIS, PC A02/MF A01. Order Number DE81030541.

From 2. workshop on EBIS and related topics; Paris, France (11 May 1981).

Measurements of cross sections for charge transfer and ionization of $H_2$ and rare-gas targets have been made with fast, highly stripped projectiles in charge states as high as 59+. We have found an empirical scaling rule for electron-capture cross section in $H_2$ valid at energies above 275 keV/amu. Similar scaling might exist for other target gases. Cross sections are generally in good agreement with theory. We have found a scaling rule for electron loss from H in collisions with a fast highly stripped projectile, based on Olson's classical-trajectory Monte-Carlo calculations, and confirmed by measurements in an $H_2$ target. We have found a similar scaling rule for net ionization of rare-gas targets, based on Olson's CTMC calculations and the independent-electron model. Measurements are essentially consistent with the scaled cross sections. Calculations and measurements of recoil-ion charge-state spectra show large cross sections for the production of highly charged slow recoil ions.

35554 **(LBL—13258) Laser-induced-fluorescence studies of fragment ions: $CH^+$ and $CD^+$.** O'Keefe, A. (Lawrence Berkeley Lab., CA (USA)). Aug 1981. Contract W-7405-ENG-48. 114p. NTIS, PC A06/MF A01. Order Number DE82001010.

Thesis.

The dynamics of ion-molecule interactions within a mass selective rf quadrupole ion trap are studied for several ion-molecule systems. Laser induced fluorescence is used as a probe of the internal energy distributions of molecular ions under collision free conditions and under controlled collision conditions. The effects of collisions at near thermal energies (0.3 to 0.5 eV) are easily understood in terms of processes such as charge transfer and other energy transfer mechanisms. The $A^1PI$ - $X^1\Sigma^+$ system of $CH^+$ and $CD^+$ has been examined under collision free conditions. The ions were produced from methane through electron impact ionization/dissociation. The observed energy distributions reflect the dynamical partitioning of dissociation exothermicity, excepting short lived electronic states. Many new transitions belonging to this electronic system have been observed and a reliable vibrational frequency for the $X^1\Sigma^+$ state has been obtained. The radiative lifetimes of $CH^+$ and $CD^+$ $A^1PI(v = 0)$ states have been measured and a revised oscillator strength for the A-X transition has been derived from this data.

35555 **High pressure luminescence of indole and substituted indoles in liquid solution.** Politis, T.G.; Drickamer, H.G. (School of Chemical Sciences and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Journal of Chemical Physics ;* **75**: No. 7, 3203-3210(1 Oct 1981).

High pressure luminescence measurements have been made on indole, 5-methoxyindole, and tryptophan in a number of solvents. Radiative and nonradiative rates have been calculated as a function of pressure. It has been shown that the nonradiative rates are determined by viscosity in all solvents except water and, to some extent, methanol for which the peak shift as well as possibly viscosity are the controlling factors. The radiative rates and the

peak position and shift have been scaled with the dielectric constant in a continuous and consistent way. Some peculiarities have been observed when water and methanol are used as solvents.

35556 **Angle-resolved photoelectron spectroscopy of $CS_2$ and COS measured with synchrotron radiation.** Carlson, T.A.; Krause, M.O.; Grimm, F.A.; Allen, J.D. Jr; Mehaffy, D.; Keller, P.R.; Taylor, J.W. (Chemistry Division, Oak Ridge National Laboratory Oak Ridge, Tennessee 37830). *Journal of Chemical Physics ;* **75**: No. 7, 3288-3292(1 Oct 1981).

Angle-resolved photoelectron spectra of $CS_2$ and COS have been taken as a function of photon energy. From these data the angular asymmetry parameter $\beta$ has been obtained for the five valence orbitals of $CS_2$ and the three least tightly bound valence orbitals of COS. Monochromatized polarized photons produced from synchrotron radiation have permitted studies from near ionization threshold up to 29 eV. The experimental data were used to evaluate previous theoretical calculations which employ a multiple scattering method. The agreement for the least tightly bound orbitals of the nonpolar $CS_2$ molecule were good. There were some problem areas, particularly with the more tightly bound orbitals of $CS_2$ and the polar molecule COS. However, when previous results for $CO_2$ are taken together with the results on $CS_2$ and COS, the calculations in general give a reasonable account of the experimental $\beta$ values and suggest that the multiple-scattering method will be useful for the study of differential cross sections of polyatomic molecules.

35557 **Laser-induced charge transfer in the $HeH^{+2}$ and $H_2^+$ quasimolecules.** Seely, J.F. (Naval Research Laboratory, Washington, D.C. 20375). *Journal of Chemical Physics ;* **75**: No. 7, 3321-3324(1 Oct 1981).

The cross sections for laser-induced charge transfer during the collisions of $He^{+2}$ and $H^+$ ions with hydrogen atoms are calculated. The electron transfer is into the n = 2 excited levels of the incident ions. Using the exact energy levels and dipole moments of the one-electron diatomic molecule, the cross sections are found to be broad functions of the wavelength of the pumping laser. For a focused laser intensity of $10^{12}$ W/cm$^2$ at a wavelength corresponding to the third harmonic of the Nd-glass laser, the calculated charge transfer cross section is greater than $10^{-15}$ cm$^2$ for the case of $He^{+2}$ incident on hydrogen. The photon-induced cross section is largest at low collision velocities where the competing collision-induced reaction is negligible.

35558 **Single rotational level fluorescence quantum yields, radiative lifetimes, and nonradiative decay rates of $S_1$ $D_2CO$ and $H_2CO(A\ ^1A_2, 4^1)$: Rotational dependence.** Shibuya, K.; Fairchild, P.W.; Lee, E.K.C. (Department of Chemistry, University of California, Irvine, California 92717). *Journal of Chemical Physics ;* **75**: No. 7, 3397-3406(1 Oct 1981).

A large number of rotational levels in the $4^1$ ($v_4' = 1$) manifold of $S_1$ formaldehyde were excited in a multipath absorption/fluorescence cell using a pulsed dye laser. Fluorescence decay times (tau/sub f//sup D/) of $D_2CO$ were measured for a number of rotational levels at 10.8 mTorr so that the apparatus could be calibrated for the measurement of fluorescence quantum yields (Phi/sub f//sup H/) of many rotational levels of $H_2CO$ at varying pressures (1—120 mTorr). For 10.8 mTorr $D_2CO$, the average values of tau/sub f//sup D/ and Phi/sub f//sup D/ were 4.8 +- 0.3 μsec and 0.66 +- 0.07, respectively. The zero pressure values of Phi/sub f//sup H/ for $H_2CO$ varied randomly from 0.0063 for J' = 13, K' = 7 (E/sub rot/ = 570.9 cm$^{-1}$) to 0.32 for J' = 2, K' = 2 (E/sub rot/ = 37.1 cm$^{-1}$), due to a random variation of the nonradiative decay rates. The J'-population averaged value of Phi/sub f//sup H/ in a given K' manifold <Phi/sub f//sup H/(J')>/sub K/' shows a trend to decrease with the increase in the K' quantum number for K' = 2—6, but becomes nearly constant for K' = 6—10. The (J', K')-population averaged value of Phi/sub f//sup H/ is <Phi/sub f//sup H/(J', K')> = 0.033 and the average value of radiative lifetimes is tau/sub r//sup H/ = 3.3 +- 1.2 μsec for the $4^1$ level.

35559 **Pressure dependence of fluorescence quantum yields and collision-induced rotational relaxation of single rotational levels of $H_2CO(A\ ^1A_2, 4^1)$.** Fairchild, P.W.; Shibuya, K.; Lee, E.K.C. (Department of Chemistry, University of California, Irvine, California 92717). *Journal of Chemical Physics ;* **75**: No. 7, 3407-3413(1 Oct 1981).

Pressure dependent values of SRL fluorescence quantum yields Phi/sub f/(J', K') in the 1—120 mTorr range are reported for 75 rotational levels (E/sup prime//sub rot/ = 37—1127 cm$^{-1}$) of $S_1$ $H_2CO$ ($4^1$). High lying rotational levels tend to show an increase in Phi/sub f/ with increasing pressure of $S_0$ $H_2CO$, whereas low lying rotational levels tend to show a decrease. For some levels, collision-induced ΔJ' transitions occur 5—10 times faster than the gas kinetic collision rate but probably with a much slower rate for ΔK' transitions. A ΔK'-constrained, collision-induced rotational relaxation model involving mainly ΔJ' = +- 1 transitions is proposed to explain the observed pressure dependence of Phi/sub f/(J', K').

35560 **Valence correlation in the $s^2d/sup\ n/$, $sd/sup\ n/+1$, and $d/sup\ n/+2$ states of the first-row transition metal atoms.** Botch, B.H.; Dunning, T.H. Jr.; Harrison, J.F. (Theoretical Chemistry Group, Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics ;* **75**: No. 7, 3466-3476(1 Oct 1981).

The major differential valence correlation effects of the lowest lying states arising from the $s^2d/sup\ n/$, $sd/sup\ n/+1$, and $d/sup\ n/+2$ configurations of the first-row transition metal atoms have been characterized using MCSCF and CI procedures. The important correlation effects are found to be, first, angular correlation of the $4s^2$ pair arising because of the near degeneracy of the 4s and 4p orbitals and, second, radial correlation of the 3d electron pairs. This large differential radial correlation of the 3d electrons can be interpreted as being due to nonequivalent d orbitals in the $sd/sup\ n/+1$ and $d/sup\ n/+2$ excited states. Both of these effects can be incorporated into a simple MCSCF wave function that reduces the error in the excited state atomic dissociation limits (~0.2 eV in Sc—Cr and ~0.5 eV in Mn—Cu for the $sd/sup\ n/+1$—$s^2d/sup\ n/$ excitation energy), yet still is of a form which lends itself easily to molecular calculations.

35561 **Defects and fluorine diffusion in sodium fluoroberyllate glass: A molecular dynamics study.** Brawer, S.A. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Chemical Physics ;* **75**: No. 7, 3516-3521(1 Oct 1981).

A mechanism for fluorine diffusion in sodium fluoroberyllate fluid and glass is described based on a molecular dynamics study. It is shown that the separation of a F from the neighborhood of a Be occurs only when the Be has a coordination number of five or more. The diffusion mechanism involves a F entering the coordination sphere of a fourfold Be, making it fivefold, after which a different F leaves the neighborhood, making the Be fourfold again. The diffusion mechanism qualitatively explains the concentration dependence of the viscosity in alkali fluoroberyllate fluids. At temperatures below the computer glass transition, where no macroscopic F diffusion occurs during a computer run, some F can still separate from fivefold Be by distances greater than 0.5 A. (In the glass, about 40% of the Be are fivefold coordinated by F.) These motions have an activation energy of 0.1 eV (compared to 0.7 eV for macroscopic diffusion). It is suggested that such sites give rise to secondary relaxations and anomalous low-temperature properties of glass.

35562 **Molecular dynamics simulations of the structure of rare-earth-doped beryllium fluoride glasses.** Brawer, S.A.; Weber, M.J. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Chemical Physics ;* **75**: No. 7, 3522-3541(1 Oct 1981).

We have simulated the atomic structure of a series of rare-earth-doped beryllium fluoride glasses using the molecular dynamics technique. Compositions include unitary $BeF_2$ and $CaF_2$ glasses and binary $BeF_2$—NaF, $BeF_2$—RbF, and $BeF_2$—$CaF_2$ glasses. Results are presented in the form of radial distribution functions and average coordination numbers about the rare-earth and other cations. In addition, by examining conditional probability distributions, we predict unusual structural features of the glasses such as a

significant number of Be ions coordinated by five fluorine nearest neighbors, and the presence of F ions with no Be nearest neighbors. It is also found that the average coordination number of all cations, including Be, increases with an increasing amount of modifier. This result has been observed experimentally for oxides. We show that our runs are sufficiently long that the structural results are not due to insufficient equilibration. The relevance of our results to problems of solubility and crystallization are also discussed. The presence of fivefold coordinated Be is expected to have a dominant effect on glass kinetic properties.

35563 **Jahn—Teller effect in the photoelectron spectrum of iron pentacarbonyl.** Hubbard, J.L.; Lichtenberger, D.L. (Department of Chemistry, University of Arizona, Tucson, Arizona 85721). *Journal of Chemical Physics ;* **75**: No. 6, 2560-2568(15 Sep 1981).

High quality photoelectron spectra of gaseous $Fe(CO)_5$ excited by HeI, HeII, and ArI photons have been obtained. Major attention is focused on the primarily metal 3d ionizations, which occur in the binding energy region from 7 to 11 eV. Ionization to the $^2E'$ positive ion state (centered at 8.6 eV) clearly shows the effects of Jahn—Teller distortions in the positive ion. This ionization results in two ionization bands of approximately equal intensity and shape separated by 0.38 eV at room temperature. These bands broaden and the splitting increases to 0.47 eV at 473 °K. Ionization to the $^2E''$ positive ion state, centered at 9.9 eV, is much less influenced by the Jahn—Tellar effect. There is no discernable splitting of this band at room temperature. These observations are discussed in terms of the electronic structure and bonding of $Fe(CO)_5$. Simple model calculations of the energies of the doubly degenerate electronic states in relation to the appropriate doubly degenerate normal vibrational modes are used to investigate the splitting. The magnitudes of the $^2E'$ and $^2E''$ splittings are reproduced very well, and the temperature dependence is reproduced within experimental error. It is found that the vibrational motion primarily responsible for the splitting is a low frequency OC—Fe—CO bending in the equatorial plane. This bending is found in two normal modes, one of which is closely related to the Berry pseudorotation process. The splitting of the $^2E'$ ionization is clear experimental evidence in the gas phase that the preferred geometry of $d^7$ $M(CO)_5$ is not D/sub 3h/ in this case.

35564 **Theory of resonance emission: Microscopic origins of stochastic modulation.** Rhodes, W. (Department of Chemistry and Institute of Molecular Biophysics, Florida State University, Tallahassee, Florida 32306). *Journal of Chemical Physics ;* **75**: No. 6, 2588-2598(15 Sep 1981).

The nature of resonance emission of light, which appears as a mixture of (coherent) resonance scattering and (incoherent) resonance fluorescence, is considered. The basic conceptual elements which distinguish the scattering and fluorescence components for the linear excitation limit are developed in terms of a simple formulation whereby a molecule interacts with a coherent Lorentzian light pulse which increases exponentially with time for $t<0$ and is turned off at $t = 0$. These results together with the ideas, currently existing in the literature, that stochastic modulation of a molecule by its medium is essential for the appearance of fluorescence provide the basis for the further formulation of a theory which does not require the ad hoc introduction of a random potential. The theory developed considers the microscopic origins of manifest stochastic modulation effects in terms of a bath potential for the molecule—medium (bath) degrees of freedom. This potential, termed the sudden potential, is associated with the change in interaction with the medium that a molecule experiences upon intramolecular state transitions which are induced by external interactions (e.g., by light). Development of the reduced molecule—field density operator leads naturally to a separation of terms which describes scattering and (the propensity for) fluorescence. Critical to the theory is a four-time correlation function for the bath (sudden) potential. The difficulties inherent in defining absorption (spectrum) resonances and the corresponding distinctions between resonance and relaxed emission are discussed. Implications are considered for the further understanding of experimental results on molecular excitation dynamics in the gas phase and in supersonic jets. Sources of stochastic modulation other than material media are mentioned.

35565 **Dissociative photoionization of $H_2$ at 26.9 and 30.5 eV.** Kirby, K.; Uzer, T.; Allison, A.C.; Dalgarno, A. (Harvard—Smithsonian Center for Astrophysics, Cambridge, Massachusetts 02138). *Journal of Chemical Physics ;* **75**: No. 6, 2820-2825(15 Sep 1981).

A quantal resonance formalism is applied to the calculation of the cross sections for the absorption of photons of energies 26.9 and 30.5 eV into a $^1\Sigma^+$/sub u/ resonance Rydberg state of $H_2$. The $^1\Sigma^+$/sub u/ state undergoes autoionization into the vibrational continuum of the $^2\Sigma^+$/sub g/ state of $H^+_2$, producing energetic $H^+$ ions. The calculations reproduce state of $H^+_2$, producing energetic $H^+$ ions. The calculations reproduce the maxima in the measured cross sections at $H^+$ energies near 3.2 eV for overestimate the cross sections below 2.5 eV. An arbitrary reduction in the autoionizing widths by a factor of 2 restores agreement over the measured energy range, though more elaborate calculations of the widths suggest that values should be increased.

35566 **Frozen Gaussians: A very simple semiclassical approximation.** Heller, E.J. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics ;* **75**: No. 6, 2923-2931(15 Sep 1981).

A new and convenient semiclassical method is proposed. It relies only upon classical trajectories and Gaussian integrals. It seems to work very well for the model molecular vibrational spectra investigated here. It should be applicable to a wide variety of processes and can be variationally improved if necessary.

35567 **Influence of collisions on coherent IR multiphoton absorption in thiophosgene.** Brenner, D.M.; Spencer, M.; Steinfeld, J.I. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics ;* **75**: No. 6, 3153-3154(15 Sep 1981).

Absolute changes due to IR pumping in the intergrated rotational population of the vibrationless level (000000) of thiophosgene have been measured under beam conditions and bulb conditions (1—1000 mTorr). Under collisionless conditions, large decreases are observed which reflect depopulation of all rotational states at a single $CO_2$ laser frequency. At higher thiophosgene pressure, less depopulation occurs; zero depopulation of the vibrationless level is observed at pressure $>$ or $=$ 300 mTorr within experimental uncertainty ($<$ or $=$ 3%). The latter agrees with measurements of the average number of photons absorbed from photoacoustic data (0.013 +- 0.001) obtained at a pressure of 500 mTorr. The results support a mechanism of coherent pumping in the low density of states regime and the existence of a long range, collision-induced dephasing interaction which has a cross section $>>$ gas kinetic.

35568 **Thermalization of sputtered atoms.** Meyer, K.; Schuller, I.K.; Falco, C.M. (Solid State Science Division, Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG.38. *Journal of Applied Physics ;* **52**: No. 9, 5803-5805(Sep 1981).

We have calculated the energy distributions of sputtered Nb and Cu atoms ejected from amorphous targets under low-energy Ar bombardment. A formula based on elementary kinetic gas theory is used to calculate the subsequent energy loss of the ejected atoms due to collisions in the sputtering gas. The energy distributions of the sputtered atoms arriving at the substrate is compared with the distributions obtained using thermal evaporation techniques. This comparison indicates that the preparation of epitaxial metallic films, such as Layered Ultrathin Coherent Structures using sputtering techniques may have fundamental advantages over thermal evaporation.

35569 **Digital technique for the study of narrow structure in electron-atom and electron-molecule scattering.** Paske, W.C.; Shadfar, S.; Lorentz, S.R.; Steph, N.C.; Golden, D.E. (Department of Physics and Astronomy, University of Oklahoma, Norman, Oklahoma 73019). *Review of Scientific Instruments ;* **52**: No. 9, 1296-1300(Sep 1981).

A digital technique has been developed which allows the study of narrow structure in total electron-atom and electron-molecule scattering cross sections without requiring a highly monoenergetic electron beam, modulation of the electron gun, or phase sensi-

tive detection. The electron current transmitted through a gas cell is digitized as the electron energy is stepped by ΔE through the energy range of interest. A transmitted electron difference signal is then obtained using a computer. As examples of this technique, the difference spectra are presented for He near 19.35 eV and for $N_2$ for the energy range from 10.3 to 15.0 eV. In the present case an instrumental resolution of 30 meV FWHM has been obtained.

35570 **Observation in a discharge of short-lived atomic states by intracavity absorption.** Brink, G.O.; Heider, S.M. (Department of Physics and Astronomy, State University of New York at Buffalo, Amherst, New York 14260). EG-77-S-02-4448. *Optics Letters ;* **6**: No. 8, 366-368(Aug 1981).

Optical absorption in short-lived excited states of atomic neon caused by dye-laser intracavity absorption has been observed. The states were excited by a microwave discharge in neon gas produced by a microwave cavity located inside the optical cavity of the dye laser. All transitions arising from the 2p manifold of states that are usually seen in emission are here seen in absorption. Best theoretical estimates of the number density of each of the 2p states in the discharge is about $10^5$—$10^7/cm^3$, and the mean lifetime of the states is about $19 \times 10^{-9}$ sec.

35571 **Semiclassical model for atoms.** Pearson, R.G. (Univ. of California, Santa Barbara). *Proceedings of the National Academy of Sciences of the United States of America ;* **78**: No. 7, 4002-4005(Jul 1981).

The energies of several two- and three-electron atoms, in both ground states and excited states, are calculated by a very simple semiclassical model. The only change from Bohr's original method is to replace definite orbits by probability distribution functions based on classical dynamics. The energies are better than Hartree-Fock values. There is still a need for an exchange-energy correction.

35572 **Comparison of numerical methods for solving the second-order differential equations of molecular scattering theory.** Thomas, L.D.; Alexander, M.H.; Johnson, B.R.; Lester, W.A. Jr.; Light, J.C.; McLenithan, K.D.; Parker, G.A.; Redmon, M.J.; Schmalz, T.G.; Secrest, D.; Walker, R.B. (National Research for Computation in Chemistry, Lawrence Berkely Laboratory, University of California, Berkeley, California 94720). W-7405-ENG-48. *Journal of Computational Physics ;* **41**: No. 1, 407-426(Jun 1981).

The numerical solution of coupled, second-order differential equations is a fundamental problem in theoretical physics and chemistry. There are presently over 20 commonly used methods. Unbiased comparisons of the methods are difficult to make and few have been attempted. Here we report a comparison of 11 different methods applied to 3 different test problems. The test problems have been constructed to approximate chemical systems of current research interest and to be representative of the state of the art in inelastic molecular collisions. All calculations were done on the same computer and the attempt was made to do all calculations to the same level of accuracy. The results of the initial tests indicated that an improved method might be obtained by using different methods in different integration regions. Such a hybrid program was developed and found to be at least 1.5 to 2.0 times faster than any individual method.

35573 **Role of collision complexes in the reaction of silyl ions with ethylene.** Abernathy, R.N.; Lampe, F.W. (Pennsylvania State Univ., University Park). AS02-76ER03416-15. *Journal of the American Chemical Society ;* **103**: No. 10, 2573-2578(20 May 1981).

The reaction of $SiH_3^+$ ions with $C_2H_4$ was studied at laboratory energies in the range of 2.5 to 4.7 eV and pressures of 0.25 to 5 mtorr, using a tandem mass spectrometric technique. In agreement with earlier work, it was found that long-lived collision complexes play a major role in the reaction. However, at the reactant-ion energies and target gas pressures studied, the traditional mechanism of collisional stabilization plays no role; the route to detectable (i.e., long-lived) complexes involves a moderation of the kinetic energy of the reactant ions via complex formation and dissociation back to reactants.

35574 **Scaled collision strengths for hydrogenic ions.** Golden, L.B.; Clark, R.E.H.; Goett, S.J.; Sampson, D.H. (Los Alamos Scientific Laboratory). DE-AC02-76ET53056.A003. *Astrophysical Journal, Supplement Series ;* **45**: No. 4, 603-612(Apr 1981).

Scaled hydrogenic ion collision strengths Z ²Ω/sub H/ and Z ²Ω/sub H//sup e/ have been calculated using the Coulomb-Born-Oppenheimer approximation for the limit $Z \rightarrow \infty$ or, equivalently, time-dependent perturbation theory with the perturbation consisting of the entire electrostatic interaction between the electrons. The results are given for all transitions n/sub a/l/sub a/ → n′/sub a/l′/sub a/ from the sublevels with n/sub a/ = 1, 2, and 3 to those with n′/sub a/ = n/sub a/+1 and n/sub a/+2 for eight impact electron energies ϵ in threshold units in the range 1< or =ϵ< or =10. Approximate collision strengths for many important transitions in He-like and Li-like ions can be obtained from these results for Z ²Ω/sub H/ and Z ²Ω/sub H//sup e/. The results for Z ²Ω/sub H/ and Z ²Ω/sub H//sup e/ are fitted to simple functions of ϵ that are readily integrated over a Maxwellian to obtain collision rates.

35575 **VLAM, a program for computing the electron-molecule static interaction potential from a Legendre expansion of the molecular charge density.** Schmid, G.B.; Norcross, D.W. (Colorado Univ., Boulder (USA). Joint Inst. for Laboratory Astrophysics; National Bureau of Standards, Boulder, CO (USA). Quantum Physics Div.); Collins, L.A. (Los Alamos Scientific Lab., NM (USA)). *Computer Physics Communications ;* **21**: No. 1, 79-90(Dec 1980).

Evaluation of the electron-molecule static interaction potential.

35576 **Chemical effects in the K-shell photoionizations of carbon monoxide, carbon dioxide and sulfur carbonyl.** Grimm, F.A. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry; Oak Ridge National Lab., TN (USA)). *Chemical Physics (Amsterdam) ;* **53**: No. 1/2, 71-75(15 Nov 1980).

The asymmetry parameter $\beta$ has been calculated using the multiple scattering model for K-shell ionization for both carbon and oxygen for the three molecules CO, $CO_2$ and OCS near threshold. The effect of the anisotropic nature of the molecular potential on the asymmetry parameter is seen in the calculations. The calculated differences in the value of $\beta$ as a function of energy are large enough to suggest that they will be easily differentiated by experiment. These results indicate that the asymmetry parameter, $\beta$, can provide a finger-print of molecular environment.

35577 **Penning discharge ion source with self-cleaning aperture.** Gavin, B.F.; MacGill, R.A.; Thatcher, R.K. (to Dept. of Energy). US Patent Application 205,398. 10 Nov 1980. 19p.

An ion source of the Penning discharge type having a self-cleaning aperture is provided by a second dynode with an exit aperture in a position opposite a first dynode, from which the ions are sputtered, two opposing cathodes, each with an anode for accelerating electrons emitted from the cathodes into a cylindrical space defined by the first and second dynode. A support gas maintained in this space is ionized by the electrons. While the cathodes are supplied with a negative pulse to emit electrons, the first dynode is supplied with a negative pulse (e.g., -300 V) to attract atoms of the ionized gas (plasma). At the same time, the second dynode may also be supplied with a small voltage that is negative with respect to the plasma (e.g., -5 V) for tuning the position of the plasma miniscus for optimum extraction geometry. When the negative pulse to the first dynode is terminated, the second dynode is driven strongly negative (e.g., -600 V) thereby allowing heavy sputtering to take place for a short period to remove virtually all of the atoms deposited on the second dynode from material sputtered off the first dynode. An extractor immediately outside the exit aperture of the second dynode is maintained at ground potential while the anode, dynode, and cathode reference voltage is driven strongly positive (about +20 kV to +30 kV) so that ions accelerated through the aperture will be at ground potential. Material from the first dynode deposited on the second dynode will be sputtered, in time, to add to the ion beam.

**35578 Direct counting of Xe atoms.** Chen, C.H.; Hurst, G.S.; Payne, M.G. (Oak Ridge National Lab., TN (USA). Health and Safety Research Div.). *Chemical Physics Letters ;* **75**: No. 3, 473-477(1 Nov 1980).

Resonance ionization spectroscopy (RIS) is making possible direct counting of inert-gas atoms. Results for Xe are presented along with considerations involved in generalizing to other inert gases. Various applications of counters for inert-gas atoms are described.

**35579 Coulomb capture ratios of negative muons in $N_2$ + $O_2$, NO, and CO.** Knight, J.D.; Orth, C.J.; Schillaci, M.E. (Los Alamos Scientific Lab., NM (USA)); Naumann, R.A. (Princeton Univ., NJ (USA)); Hartmann, F.J. (Technische Univ. Muenchen, Garching (Germany, F.R.). Fachbereich Physik); Reidy, J.J. (Mississippi Univ., University (USA)); Schneuwly, H. (Fribourg Univ. (Switzerland). Inst. de Physique). *Physics Letters [Section] A ;* **79**: No. 5/6, 377-379(27 Oct 1980).

We have measured relative Coulomb capture rates of negative muons in the gas targets $N_2$ + $O_2$, NO, and CO at 10 atm. The results indicate the molecular dipole orientation $^-NO^+$.

**35580 Design and performance evaluation of a new high-performance mass-analyzed ion kinetic energy (MIKE) spectrometer.** Russell, D.H.; Smith, D.H.; Warmack, R.J.; Bertram, L.K. (Oak Ridge National Lab., TN (USA). Analytical Chemistry Div.). *Journal of Mass Spectrometry and Ion Physics ;* **35**: No. 3/4, 381-391(Sep 1980).

The design and performance of a new high-resolution mass-analyzed ion kinetic energy (MIKE) spectrometer are described. The instrument is composed of three sectors, i.e. electric sector/magnet/electric sector, and has partial second-order double focussing (maximum resolving power ca. 30 000). The performance of the instrument as a MIKE spectrometer is described. In the MIKE scan mode, energy resolutions of 6000-8000 are routinely achievable. In addition, the combined high mass resolution/MIKE (resolving power 15 000) capability unique to the three-sector configuration is described.

## 6404 Fluid Physics

**35581 (LBL—13227) Diffusion of gases in capillaries.** Jacobson, N.S. (Lawrence Berkeley Lab., CA (USA)). Aug 1981. Contract W-7405-ENG-48. 108p. NTIS, PC A06/MF A01. Order Number DE82000267.

Thesis.

Two aspects of the diffusion of gases in capillaries are explored. In Part I a Monte Carlo computer simulation of Knudsen flow is adapted to count collisions and record collision distributions. Using this simulation, the behavior of gases in both open and closed end tubes is examined. Given a tube with one end closed and a length-to-radius ratio of L/R, it is shown that a molecule that enters this tube will strike the wall an average of 2 L/R times before escaping. It is also shown that most molecules do not travel very far into the pore. However, those that reach the pore bottom usually strike the walls many times before escaping. The average number of collisions a molecule undergoes in passing through an open-end capillary is also calculated. If the reaction probability is already known, the processes in a supported catalyst can be simulated. From this analysis the distribution of active material, pore size, and pellet diameter can be optimized for a given reaction. Part II is an experimental study of Knudsen and surface diffusion in porous alumina. This material had pores 1.1 to 1.3$\mu$ in diameter and was used as barriers 1.124 to .114 mm thick. It is shown that He, Ar, $N_2$, $O_2$, $CO_2$, $CH_4$, $NH_3$, and $SO_2$ all pass through these barriers by Knudsen diffusion at room temperature. At 631°K, zinc vapor also passes through this material by Knudsen flow. However, NaCl, NaF, and LiF vapors show substantial elements of surface diffusion with surface flux to Knudsen flux ratios of 1.6, 5.1, and 11.2, respectively.

**35582 Existence of the dielectric constant in dipolar fluid mixtures.** Ramshaw, J.D.; Hamer, N.D. (Theoretical Division, University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics ;* **75**: No. 7, 3511-3515(1 Oct 1981).

The existence of the dielectric constant $\epsilon$ is investigated for fluid mixtures of rigid polar molecules. The investigation is performed using the functional-derivative formalism for mixtures, and is closely analogous to that previously carried out for pure dipolar fluids [J. Chem. Phys. 68, 5199 (1978)]. Sufficient conditions for the existence of $\epsilon$ are obtained in terms of the direct correlation function matrix c/sub alphabeta/(12). It is found that $\epsilon$ exists if c/sub alphabeta/(12) depends only on relative positions and orientations, and becomes asymptotic to -$\theta$/sub alphabeta/(12)/kT at long range, where $\theta$/sub alphabeta/(12) is the dipole—dipole potential between a molecule of species $\alpha$ and one of species $\beta$. An expression for $\epsilon$ in terms of the short-range total correlation function matrix emerges automatically from the development. This expression is equivalent to an earlier result obtained by a different method. Expressions for $\epsilon$ in terms of c/sub alphabeta/(12) are derived for axially symmetric molecules and for molecules of arbitrary symmetry. In the former case, the expression involves the inverse of an N/sub c/ x N/sub c/ matrix, where N/sub c/ is the number of components in the mixture. This expression facilitates the evaluation of $\epsilon$ in the mean spherical approximation. For molecules of arbitrary symmetry, the expression for $\epsilon$ in terms of c/sub alphabeta/(12) involves the inverse of an N/sub c/ x N/sub c/ supermatrix, each element of which is a 3 x 3 matrix.

**35583 Macroscopic solitons in thermodynamics.** Ventura, I. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). DE-AC02-76ER03069. *Physical Review [Section] B: Condensed Matter ;* **24**: No. 5, 2812-2816(1 Sep 1981).

We examine semiclassically the phi$^4$ theory in three space dimensions, and relate the circumstances which allow its macroscopic kinks to arise spontaneously in the system.

## 6451 Particle Interactions And Properties - Experimental

*REFER ALSO TO CITATION(S) 35628*

**35584 (BNL—29984) Kaon-induced nuclear reactions.** Dover, C.B. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 12p. (CONF-810869—1). NTIS, PC A02/MF A01. Order Number DE81030552.

From TRIUMF kaon factory physics workshop; Vancouver, Canada (10 Aug 1981).

Some reactions which could be studied at a future kaon factory are discussed. These include elastic and inelastic regeneration of neutral kaons on nuclei, production of high spin $\Lambda$ and $\Sigma$ hypernuclear states via the ($\pi$/sup +-/,$K^+$) reaction, and the ($K^-$,$K^+$) process as a means of exploring the spectroscopy of doubly strange hypernuclei.

**35585 (UH—511-328-79) Study of neutrino-produced dimuons using the Fermilab 15-foot bubble chamber and external muon identifier.** Peterson, V.Z. (Hawaii Univ., Honolulu (USA)). Jan 1979. Contract AC03-76ER00511. 21p. (CONF-780892—2). NTIS, PC A02/MF A01. Order Number DE81025788.

From Bubble chamber symposium; Sandai, Japan (17 Aug 1978).

The external muon identifier and the new internal picket fence, special features of the Fermilab 15-foot bubble-chamber hybrid system, are described. (GHT)

**35586 Hadron-production mechanisms in antineutrino-proton charged-current interactions.** Derrick, M.; Gregory, P.; LoPinto, F.; Musgrave, B.; Schlereth, J.; Schreiner, P.; Singer, R.; Barish, S.J.; Brock, R.; Engler, A.; Kikuchi, T.; Kraemer, R.W.; Messing, F.; Stacey, B.J.; Tabak, M.; Barnes, V.E.; Carmony, D.D.; Fernandez, E.; Garfinkel, A.F.; Laasanen, A.T. (Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Physical Review [Section] D: Particles and Fields ;* **24**: No. 5, 1071-1096(1 Sep 1981).

In this paper we present results on hadronic production in antineutrino-proton interactions. The data sample, which consists of 2033 charged-current events with antineutrino energy above 5 GeV, comes from exposures of the 15-foot hydrogen bubble chamber to the Fermilab broad-band antineutrino beam. The results are discussed in terms of both their exclusive-channel components and the deep-inelastic part of the data, for which the total hadronic mass W and the lepton four-momentum transfer $Q^2$ are large. The current-quark fragmentation shows properties in good agreement with the simple quark-parton model. In particular, the data show no evidence for scaling violations or breakdown of the factorization hypothesis when the selections appropriate to obtaining the current-quark fragments are used. The jetlike features of the events and the energy and charge correlations in the quark fragmentation region are in reasonable agreement with the standard jet model of Field and Feynman. However, these features and the transverse-momentum properties of the current-quark fragments also follow phase-space predictions. The characteristics of the spectator-diquark (target fragmentation) system are presented. These features are compared to those of the current-quark system and to some predictions of quark-fusion models for proton fragmentation.

**35587 Measurement of elastic $\nu$/sub $\mu$/ and nu-bar/sub $\mu$/ scattering on protons.** Coteus, P.; Diesburg, M.; Fine, R.; Lee, W.; Sokolsky, P.; Brown, R.; Fuess, S.; Nienaber, P.; O'Halloran, T. Jr.; Lee, Y.Y. (Columbia University, New York, New York 10027). *Physical Review [Section] D: Particles and Fields ;* **24**: No. 5, 1420-1423(1 Sep 1981).

We have measured elastic $\nu$/sub $\mu$/ and nu-bar/sub $\mu$/ scattering on protons at the Brookhaven National Laboratory Alternating Gradient Synchrotron. We find R/sub NC/ = $\sigma$(nu-bar/sub $\mu$/ p→nu-bar/sub $\mu$/p) / $\sigma$($\nu$/sub $\mu$/p→$\nu$/sub $\mu$/p) = 0.44 +- 0.12 and R/sub numu/ = $\sigma$($\nu$/sub $\mu$/p→$\nu$/sub $\mu$/p)/$\sigma$($\nu$/sub $\mu$/n→$\mu^-$ p) = 0.11 +- 0.03. The elastic $Q^2$ distribution is in good agreement with present knowledge of form factors and the Weinberg-Salam model. We find $\sin^2\theta$/sub W/ = 0.26 +- 0.06.

**35588 Charge compensation in the quark jets.** Orava, R. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review [Section] D: Particles and Fields ;* **24**: No. 5, 1424-1427(1 Sep 1981).

We sum cumulatively charges of hadrons produced over the range of rapidities in antineutrino-nucleon charged-current interactions and show that the hypothesis of local charge conservation is approximately valid above center-of-mass energies of 4 GeV. Charge compensation in the current fragmentation region seems to occur in a shorter rapidity interval than in proton-proton interactions at comparable center-of-mass energies.

**35589 Possible deviations from (V-A) charged currents: Prcise measurement of muon decay parameters.** Strovink, M. (University of California, Berkeley, California 94720). W-7405-ENG-48. *AIP (American Institute of Physics) Conference Proceedings ;* **72**: No. 1, 46-77(May 1981). (CONF-801244—).

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

This short review examines the experimental limits on possible deviations from (V-A) charged weak currents, as would occur at some mass scale, for example, in manifestly left-right-symmetric electroweak theories.

**35590 Nucleon decay experiments.** Cherry, M.; Lande, K.; Lee, C.K.; Steinberg, R.I. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19104). DE-AC02-81ER40012. *AIP (American Institute of Physics) Conference Proceedings ;* **72**: No. 1, 128-141(May 1981). (CONF-801244—).

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

Some practical problems in the detection of proton decay are discussed. (AIP)

**35591 Proposed experiment for a sensitive search for $\Delta B = 2$ transitions via n-n-bar mixing.** Young, G.R.; Cohn, H.O.; Gabriel, T.A.; Lillie, R.A.; Miller, P.D.; Spencer, R.R.; Goodman, M.S.; Wilson, R.; Bugg, W.M.; Condo, G.T.; Handler, T.; Hart, E.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *AIP (American Institute of Physics) Conference Proceedings ;* **72**: No. 1, 159-191(May 1981). (CONF-801244—).

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

Employing the Oak Ridge Research Reactor to study n-n-bar mixing is proposed. (AIP)

**35592 Solar neutrino experiments and neutrino oscillators.** Cleveland, B.T.; Davis, R. Jr.; Rowley, J.K. (Brookhaven National Laboratory, Upton, New York 11973). *AIP (American Institute of Physics) Conference Proceedings ;* **72**: No. 1, 322-334(May 1981). (CONF-801244—).

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

This report will give the results of the Brookhaven solar neutrino experiment that is based upon the neutrino capture reaction, $^{37}Cl$ $(\nu,e^-)^{37}Ar$. The experiment was built in 1967 to test the theory of solar energy production, and it is well known that the neutrino capture rate in the detector is lower than that expected from theoretical models of the sun. The results will be compared to the current solar model calculations. One possible explanation of the low solar neutrino capture rate is that the neutrinos oscillate between two or more neutrino states, a topic of particular interest to this conference. We will discuss this question in relation to the $^{37}Cl$ experiment, and to other solar neutrino detectors that are capable of observing the lower energy neutrinos from the sun. A radiochemical solar neutrino detector located deep underground has a very low background and is capable of detecting the monoenergetic neutrinos from megacurie sources of radioisotopes that decay by electron capture. Experiments of this nature will be described that are capable of testing for neutrino oscillations with a $\delta m^2$ as low as 0.2 $eV^2$ if there is maximum mixing between the neutrino states.

**35593 Rare muon processes.** Mischke, R.E. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings ;* **72**: No. 1, 355-367(May 1981). (CONF-801244—).

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

Muon→electron conversion studies in various nuclei are reviewed as part of a study of lepton number nonconservation. (AIP)

**35594 Review of new experimental upper limits on forbidden decay modes of the tau lepton.** Hayes, K.G.; Perl, M.L. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515;W-7405-ENG-48. *AIP (American Institute of Physics) Conference Proceedings ;* **72**: No. 1, 602-613(May 1981).

THis paper presents a review of experimental upper limits on the branching fractions for various forbidden decay modes of the tau lepton. These are modes which cannot occur in the conventional model in which the tau and its associated neutrino have a unique, conserved lepton number. The limits are based on data acquired by the Mark II Detector Collaboration at SPEAR.

**35595 One- and two-proton inclusive spectra in 800 MeV proton-nucleus collisions and the mean free path of protons in nuclei.** Tanihata, I.; Nagamiya, S.; Schnetzler, S.; Steiner, H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., Berkeley (USA). Dept. of Physics). *Physics Letters,* [*Section*] *B ;* **100**: No. 2, 121-125(26 Mar 1981).

One- and two-proton inclusive spectra have been measured in collisions of 800 MeV protons with C, NaF, KCl, Cu, and Pb targets. The single proton inclusive yield increases monotonically with target mass, while the two-proton yield at theta = +- 40° associated with pp quasi-elastic scatterings shows a maximum at a mass number of about 50. A model calculation reproduces the observed target mass dependence with a mean free path of approx. 2.4 fm for 800 MeV protons inside the nucleus.

**35596 Observed difference in the structure of events with a high psub(T)$\pi$0 or single photon.** Kourkoumelis, C.; Resvanis, L.K. (Athens Univ. (Greece)); Filippas, T.A.; Fokitis, E. (National Technical Univ., Athens (Greece)); Cnops, A.M.; Iwata, S.; Palmer, R.B.; Rahm, D.C.; Rehak, P.; Stumer, I. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Physics* [*Section*] *B ;* **179**: No. 1, 1-8(23 Feb 1981).

The rapidity correlation ($\Delta\gamma$) and the azimuthal correlation ($\Delta$phi) between a $\pi^0$ or single photon trigger particle and an additional charged particle or $\pi^0$ were measured at the CERN Intersecting Storage Rings. It is observed that same-side correlations depend on the nature of the trigger particle, the differences appearing mainly at small $\Delta\gamma$ and $\Delta$phi. This effect becomes more pronounced when the psub(T) of the second $\pi^0$ is increased. The results are consistent with the hypothesis that $\pi^0$ events have additional associated particles, while single photons have significantly fewer, if any, additional associated particles.

**35597 Production and decay of $F^+(2030)$ observed in vsub($\mu$) interactions in emulsion.** Ammar, R.; Coppage, D.; Davis, R.; Kwak, N.; Riemer, R.; Stump, R. (Kansas Univ., Lawrence (USA)); Kautzky, H.; Smart, W.; Velen, S.; Voyvodic, L. (Fermi National Accelerator Lab., Batavia, IL (USA)). *Physics Letters,* [*Section*] *B ;* **94**: No. 1, 118-122(Jul 1980).

An event representing the production and decay of the charmed $F^+$ meson has been identified by means of a 3-constraint fit to the decay hypothesis $F^+ \rightarrow \pi^+\pi^-\pi^0$, in which both $\gamma$-rays from the $\pi^0$ converted. The event was produced by a charged current vsub($\mu$) interaction in an emulsion stack located inside the Fermilab 15-foot bubble chamber. The $F^+$ traveled 50 $\mu$m, corresponding to a proper time of 1.4 x $10^{-13}$ seconds, before decaying in flight. Its mass was determined to be 2017 +- 25 MeV.

## 6452 Particle Interactions And Properties - Theoretical

*REFER ALSO TO CITATION(S) 35623*

**35598 (DOE/ER/01388—861) Quark-gluon plasma and the little bang.** McLerran, L. (Washington Univ., Seattle (USA). Dept. of Physics). Jun 1981. Contract AC06-76ER01388. 32p. (CONF-8105109—2). NTIS, PC A03/MF A01. Order Number DE81030320.

From International conference on physics in collision: High energy ee/ep/pp interactions; Blacksburg, VA, USA (28 May 1981).

A space-time picture of the fragmentation and central regions is presented for extremely high energy head-on heavy nucleus collisions. The energy densities of the matter produced in such collisions are estimated. Speculations concerning the possible formation of a quark-gluon plasma are discussed, as are possible experimental signals for analyzing such a plasma.

**35599 Photon-photon interactions.** Gilman, F.J. (Stanford Linear Accelerator Center, CA (USA)). *Nuclear Physics* [*Section*] *A ;* **353**: No. 1/2, 267-270(16 Feb 1981).

From 9. international conference on the few-body problem; Eugene, OR, USA (17 - 23 Aug 1980).

A brief summary of the present status of photon-photon interactions is presented. Stress is placed on the use of two-photon collisions to test present ideas on the quark constituents of hadrons and on the theory of strong interactions.

**35600 Inclusive particle production in 100 GeV/c $\pi$pp and anti pp interactions.** Nandi, A.K.; Ansorge, R.E.; Carter, J.R.; Neale, W.W.; Rushbrooke, J.G.; Ward, C.P.; Ward, D.R. (Cambridge Univ. (UK). Cavendish Lab.); Moore, C.; Raja, R.; Voyvodic, L. (Fermi National Accelerator Lab., Batavia, IL (USA)). *Nuclear Physics* [*Section*] *B ;* **169**: No. 1/2, 20-48(Jun-Jul 1980).

We discuss a number of features of $\pi^-$p interactions at 100 GeV/c, and in particular we attempt to understand the differences between $\pi^-$p and anti pp interactions using anti pp data from the same experiments. The topics considered include the rates of strange particle production, charge transfer distributions, the partition of energy among various particle species and inclusive meson production in beam and target fragmentation regions, with special reference to constituent models of hadrons.

**35601 Renormalization group for many-particle exclusive and exclusive semi-inclusive processes.** Gupta, S. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515. *Physical Review* [*Section*] *D: Particles and Fields ;* **24**: No. 5, 1169-1176(1 Sep 1981).

In this paper it is shown that in quantum chromodynamics a new set of high-energy processes is calculable. Firstly, many meson exclusive processes are shown to be controllable. Secondly, a new type of exclusive semi-inclusive meson process (for example $e^+ + e^- \rightarrow \pi$/sub cone/+ anything, where $\pi$ is unaccompanied in phase space) is shown to be controllable by the renormalization-group approach. Possible experimental confrontation is discussed.

**35602 Quantum-chromodynamic predictions for direct photons in $e^+e^-$ collisions.** Sasaki, K. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515. *Physical Review* [*Section*] *D: Particles and Fields ;* **24**: No. 5, 1177-1190(1 Sep 1981).

We analyze the direct photon production in $e^+e^-$ collisions in quantum chromodynamics using the cut-vertex formalism and the renormalization-group method. The two-loop anomalous dimensions of timelike cut vertices are calculated from the two-loop parton decay probability functions. The moments of the transverse structure function W-bar/sup $\gamma$//sub T/ are calculated up to the next-to-leading order. The nonleading corrections to W-bar/sup $\gamma$//sub T/ turn out to be large, and even larger than those to the photon structure function F/sup $\gamma$/$_2$ in photon-photon scattering. Also, the moments of the longitudinal structure function W-bar/sup $\gamma$//sub L/ are calculated in the leading order. The corrections are found to be small.

**35603 Photon structure functions and azimuthal asymmetries in two-photon processes.** Higuchi, A.; Matsuda, S.; Kodaira, J. (Department of Physics, Kyoto University, Kyoto 606, Japan). DE-AC03-76SF00515. *Physical Review* [*Section*] *D: Particles and Fields ;* **24**: No. 5, 1191-1206(1 Sep 1981).

Based on the recently developed framework of Curci, Furmanski, and Petronzio, we derive the photon structure functions in quantum chromodynamics (QCD). Then we perform QCD calculations for the azimuthal asymmetries of jets in two-photon processes. We find that in contrast to the case of lepton-hadron scatterings, the deep-inelastic $e^+e^-$ reaction via two-photon exchange is expected to show cleaner signatures for the azimuthal asymmetries as a result of enhanced QCD effects. We suggest that these will serve as useful tests of QCD.

**35604 Analysis of the J/sup P/ = $1^+$ and $0^-$ three-pion systems.** Aaron, R.; Longacre, R.S. (Department of Physics, Northeastern University, Boston, Massachusetts 02115). DE-AC02-76CH00016. *Physical Review* [*Section*] *D: Particles and Fields ;* **24**: No. 5, 1207-1217(1 Sep 1981).

We analyze 3$\pi$ production results obtained from recent diffractive and charge-exchange experiments. We find that two resonances, a J/sup P/ = $1^+$ ($A_1$) and a J/sup P/ = $0^-$ ($\pi'$) are required by the data. The resonance parameters are M/sub A/1 = 1230 +- 30 MeV, $\Gamma$/sub A/1 = 350 +- 60 MeV, and M/sub piprime/ =

1273 +- 50 MeV, Γ/sub piprime/ = 580 +- 100 MeV. We interpret the above resonances in terms of qq-bar and $q^2q\text{-}bar^2$ quark-model states.

35605 **Study of b couplings in the standard weak doublet model and in models without a t quark.** Barger, V.; Keung, W.Y.; Phillips, R.J.N. (Physics Department, University of Wisconsin: Madison, Madison, Wisconsin 53706). *Physical Review [Section] D: Particles and Fields ;* **24**: No. 5, 1328-1342(1 Sep 1981).

In the context of five-quark models without a t quark, both left-handed b-singlet and right-handed b-doublet options are of interest. We explore the implications of these models, contrasting their predictions with those of the standard six-quark model. In B-meson decays, the singlet model predicts neutral-current modes at a significant level, whereas the (c,b)/sub R/ model more closely resembles the standard model. The soft and hard components of the single-lepton energy spectrum can both be used to discriminate between the three classes of models. In neutrino interactions the most promising mechanism is b production from c quarks, which we study in the gluon-fusion and intrinsic-charm models. The b cross section is much larger for the (c,b)/sub R/ model. Rates for multi-lepton final states that might be realized from decays of b and its associated charm spectator are discussed.

35606 **Further studies of Fermi-motion effects in lepton scattering from nuclear targets.** Bodek, A.; Ritchie, J.L. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). DE-AC02-76ER13065. *Physical Review [Section] D: Particles and Fields ;* **24**: No. 5, 1400-1402(1 Sep 1981).

We have calculated the ratio of deep-inelastic structure functions of nuclear targets to the sum of free-neutron and -proton structure functions. The calculations incorporate structure-function fits which are based on quantum-chromodynamic considerations. This paper is an addendum to an earlier publication in which we calculated the Fermi-motion corrections using other fits to the nucleon structure functions.

35607 **Diffractive production of charm.** Barger, V.; Halzen, F.; Keung, W.Y. (Physics Department, University of Wisconsin: Madison, Madison Wisconsin 53706). *Physical Review [Section] D: Particles and Fields ;* **24**: No. 5, 1428-1430(1 Sep 1981).

A perturbative quantum-chromodynamics (QCD) analysis of heavy-quark production in hadron collisions is shown to account for the observed diffractive $\Lambda^+$/sub c/ production. The dominant graphs are flavor excitation by gluons (qc-bar→qc-bar and gc-bar→gc-bar) of charm. The source of the charm is QCD evolution of the structure functions of the incoming hadrons. Estimates are made for the $\Lambda^0$/sub b/ cross section.

35608 **Neutron-antineutron oscillations in an applied magnetic field.** Arndt, R.A.; Prasad, V.B.; Riazuddin, R. (Department of Physics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *Physical Review [Section] D: Particles and Fields ;* **24**: No. 5, 1431-1433(1 Sep 1981).

The phenomenology of neutron-antineutron (n-n-bar) oscillations in the presence of an applied external magnetic field is developed. Conditions are derived for optimizing the growth of n-bar probability in a neutron beam. For the case of a space-varying field (precession around a field axis), no "long-time" or "high-field" solutions exist. For the case of a time-varying filed, long-time solutions exist but with a quadratic growth coefficient about 1/3 that of the degaussed (zero-field) solution. No high-field solutions were found to be better than the zero-field solutions. However, it may be experimentally advantageous to apply a driving field instead of degaussing to the levels required for the zero-field case.

35609 **Current phenomenological status of Higgs physics and technicolor.** Kane, G.L. (Randall Laboratory of Physics, University of Michigan, Ann Arbor, Michigan 49109). *AIP (American Institute of Physics) Conference Proceedings ;* **72**: No. 1, 257-269(May 1981). (CONF-801244—).

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

The present situation concerning experimental constraints on Higgs physics is reviewed. (AIP)

35610 **W's and Z's.** Trueman, T.L. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *AIP (American Institute of Physics) Conference Proceedings ;* **72**: No. 1, 285-308(May 1981). (CONF-801244—).

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

Properties of intermediate vector bosons are given as predicted by QCD, Drell-Yan, and Weinberg-Salam. (AIP)

35611 **Neutrino oscillations.** Barger, V. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). DE-AC0276ER00881-187. *AIP (American Institute of Physics) Conference Proceedings ;* **72**: No. 1, 309-321(May 1981). (CONF-801244—).

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

Aspects of neutrino oscillation phenomenology are discussed, including correlations of oscillation averages, a reexamination of solar neutrino oscillations, possible tests for CP violation in the neutrino sector, the results of reactor measurements, future prospects with deep mine experiments, and the possibility of doublet-singlet neutrino oscillations.

35612 **Phenomenology of CP violation from the Kobayashi-Maskawa model.** Wang, L.C. (Brookhaven National Laboratory, Upton, New York 11973). *AIP (American Institute of Physics) Conference Proceedings ;* **72**: No. 1, 419-431(May 1981). (CONF-801244—).

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

In this talk I shall focus mostly on discussing the CP violation consequences of the K-M model, which Kobayashi, Maskawa introduced in '77 for the purpose of incorporating CP violation via the complexity in the mixing matrix of the quarks. Much of the talk is reviewing current work on the subject. Some new results of mine on the CP violation effects in exclusive and inclusive decays of bottom, charm and strange particles are also given.

35613 **Multi-generational models of quarks and leptons horizontal symmetries.** Wali, K.C. (Physics Department, Syracuse University, Syracuse, New York 13210). DE-AS02-65ER03533. *AIP (American Institute of Physics) Conference Proceedings ;* **72**: No. 1, 455-466(May 1981). (CONF-801244—).

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

The nature and consequences of intragenertional interactions are summarized in terms of SO groups. (AIP)

35614 **Gauge hierarchy and decoupling.** Yao, Y. (Department of Physics, University of Michigan, Ann Arbor, Michigan 48109). *AIP (American Institute of Physics) Conference Proceedings ;* **72**: No. 1, 494-504(May 1981). (CONF-801244—).

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

Vacuum expectation values are calculated in grand unification theories. (AIP)

35615 **Physical implications of dynamical symmetry breaking.** Beg, M.A.B. (The Rockefeller University, New York, New York 10021). DE-AC02-76ER02232B. *AIP (American Institute of Physics) Conference Proceedings ;* **72**: No. 1, 505-514(May 1981). (CONF-801244—).

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

Some model-independent physical implications of a class of hypercolorbased theories of dynamical symmetry-breaking are described and discussed. The role which $e^+e^-$ colliders can play, in distinguishing between such theories and the canonical methodology, is underlined.

**35616 M/sub Z/cos$\theta$ = M/sub W/ and the quantum number of dynamical Higgs bosons.** Tsao, H. (Rockefeller University, New York, New York 10021). DE-AC02-76ER02232B.000. *AIP (American Institute of Physics) Conference Proceedings ;* **72**: No. 1, 523-527(May 1981). (CONF-801244—).

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

It is shown that the dynamically broken symmetry M/sub z/ cos$\theta$ = M/sub w/ is a result of the maximum parity violating nature of the techni-fermion representation. (AIP)

**35617 Generating mass without Higgs fields.** Huang, K. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts, USA 02139). DE-AC02-76ER0369. *AIP (American Institute of Physics) Conference Proceedings ;* **72**: No. 1, 528-533(May 1981). (CONF-801244—).

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

In the Weinberg-Salam model, as in the various grand unification, models, Higgs fields were introduced to endow particles with mass in a gauge-invariant way. These Higgs fields seem to be undesirable features of the theory, for they bring with them a large number of arbitrary parameters. Most likely, they are phenomenological order parameters not unlike the Ginsberg-Landau order parameter in superconductivity. I shall describe some work done, in collaboration with my graduate student Roberto Mendel that attempts to generate masses spontaneously, without Higgs fields. (AIP)

**35618 F-meson production in $e^+e^-$ annihilation.** Flory, C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Physics Letters,* [*Section*] *B ;* **99**: No. 4, 365-368(26 Feb 1981).

The F-meson production rate is calculated on the psi(4414) resonance using non-relativistic multipole expansion techniques. The results are compared with the available data.

**35619 Pseudo resonance behaviour in nucleon-nucleon scattering.** Kloet, W.M. (Rutgers - the State Univ., New Brunswick, NJ (USA). Dept. of Physics and Astronomy); Tjon, J.A. (Rijksuniversiteit Utrecht (Netherlands). Inst. voor Theoretische Fysica); Silbar, R.R. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). *Physics Letters,* [*Section*] *B ;* **99**: No. 2, 80-84(12 Feb 1981).

In a relativistic unitary model for intermediate energy nucleon-nucleon scattering there are strong indications that the resonance-like looping behavior of the $^3F_3$ and $^1D_2$ amplitudes is not due to a resonance pole but to the coupling with the inelastic NN$\pi$ channel. In its most simple form the looping behavior is caused by a square root branch cut.

**35620 Possible existence of stable four-quark scalar mesons with charm and strangeness.** Isgur, N. (Toronto Univ., Ontario (Canada). Dept. of Physics); Lipkin, H.J. (Argonne National Lab., IL (USA); Fermi National Accelerator Lab., Batavia, IL (USA); Weizmann Inst. of Science, Rehovoth (Israel)). *Physics Letters,* [*Section*] *B ;* **99**: No. 2, 151-153(12 Feb 1981).

We observe that the existence of the Ssup(*) and delta just below Kanti K threshold has a natural interpretation in the four-quark model for these states, and we apply this interpretation to predict the possible existence of stable four-quark scalar mesons with charm and strangeness.

**35621 Magnetic moments of composite fermions.** Shaw, G.; Silverman, D. (California Univ., Irvine (USA). Dept. of Physics); Slansky, R. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). *Physics Letters,* [*Section*] *B ;* **94**: No. 1, 57-60(Jul 1980).

There have been a considerable number of papers proposing composite models for leptons and quarks. Recently, Glueck and Lipkin have stated that reproducing the observed magnetic moments of these fermions presents a serious difficulty for these composite models. We show for a renormalizable theory that, in contrast to Glueck's and Lipkin's nonrelativistic arguments, a deeply bound system (with heavy constituent particle masses msub(c)) of (total) spin 1/2, charge e and mass m has the magnetic moment (e/2m) [1 + 'usual' (QED + QCD + weak) corrections + O(m/msub(c)) 'new' binding corrections]. Although there remains the considerable dynamical problem of obtaining 'light' bound fermions from heavy constituents, there is no separate, additional magnetic moment difficulty.

**35622 Penguins in $\Delta S = 1$ nonleptonic weak decays.** Hill, C.T. (Fermi National Accelerator Lab., Batavia, IL (USA)); Ross, G.G. (Oxford Univ. (UK). Dept. of Theoretical Physics). *Physics Letters,* [*Section*] *B ;* **94**: No. 2, 234-238(Jul 1980).

We discuss the use of the operator product expansion in computing nonleptonic weak decays. The estimate of 'penguin' contributions is improved by a careful treatment of the u-c cancellation. Using the vacuum insertion technique and equations of motion to estimate the operator matrix element we find the penguin contribution is only 1/10 of the experimentally observed $\Delta I = 1/2$ amplitude in kaon or hyperon decays.

## 6453 Particle Invariance Principles And Symmetries

*REFER ALSO TO CITATION(S) 35538, 35539*

**35623 Model-independent analysis of experimental baryon magnetic moments.** Lipkin, H.J. (Fermi National Accelerator Laboratory, Batavia, Illinois 60519). *Physical Review* [*Section*] *D: Particles and Fields ;* **24**: No. 5, 1437-1440(1 Sep 1981).

Strong disagreement between experimental hyperon magnetic moments and simple model predictions is exhibited in the function R(p, $\Sigma^+$, $\Xi$) = 3($\mu$/sub p/-$\mu$+)/($\mu$- -$\mu$0) = 2.7 +- 0.8, an order of magnitude larger than the broken-SU(6) prediction 0.34. This is shown to imply quenching of contributions of nonstrange quarks in strange-baryon magnetic moments, relative to contributions in the nucleon. The model-independent analysis includes SU (6)-symmetry breaking, configuration mixing, relativistic corrections, and quark-diquark correlations.

**35624 Representations of supergroups.** Balantekin, A.B.; Bars, I. (Wright Nuclear Structure Laboratory, Physics Department, Yale University, New Haven, Connecticut 06520). DE-ACO2-76ER0374; EY-76-C-02-3075. *Journal of Mathematical Physics (New York) ;* **22**: No. 8, 1810-1818(Aug 1981).

An explicit construction of representations of supergroups is given in terms of direct products of covariant and contravariant fundamental representations. The rules of supersymmetrization are characterized by extended Young supertableaux. This constructive approach leads to explicit transformation properties of higher representations as well as to closed explicit formulas for characters from which other invariants such as dimensions and eigenvalues of all Casimir operators can be calculated. We have applied this approach so far to the supergroups SU(N/M), OSP(N/2M), P(N), for which we have obtained all the representations constructible as direct products of the fundamental (defining) representations. An argument is presented toward the irreducibility of all these representations.

## 6454 Field Theory

*REFER ALSO TO CITATION(S) 35538, 35601, 35602, 35603, 35607, 35610, 35615, 35617*

**35625 (BNL—29987) Oasis in the desert: weakly broken parity in grand unified theories.** Senjanovic, G. (Brookhaven National Lab., Upton, NY (USA); European Organization for Nuclear Research, Geneva (Switzerland)). Jul 1981. Contract AC02-76CH00016. 21p. (CONF-8105114—1). NTIS, PC A02/MF A01. Order Number DE81031963.

From 4. Warsaw symposium on elementary particle physics; Kazimierz, Poland (May 1981).

A discussion of low energy parity restoration in simple grand unified theories, such as SO(10), is presented. The consistency of phenomenological requirements and unification constraints is emphasized and various predictions of the theory are stressed, in particular: substantially lighter W and Z bosons than in the standard model and increased stability of the proton with tau/sub p/ ≅ $10^{33}$ years.

35626 **(DOE/ER/01388—859) Life on the edge of phase space [a continuing saga] or summing logs for fun, profit and O.J.** Ellis, S.D. (Washington Univ., Seattle (USA). Dept. of Physics). Jun 1981. Contract AC06-76ER01388. 22p. (CONF-810368—5; RLO—1388-859). NTIS, PC A02/MF A01. Order Number DE81030322.

From Conference on perturbative quantum chromodynamics; Tallahassee, FL, USA (25 Mar 1981).

The structure of perturbative quantum chromodynamics in kinematic regimes characterized by two large but very different mass scales is discussed. The various levels of approximation used to study these regimes are viewed. Of particular interest is the behavior for extremely different scales where the simplest approximation predicts a suppression. A more refined approximation suggests the absence of any suppression but it is argued that only a much more detailed analysis can supply a definitive answer to this issue.

35627 **(SLAC-PUB—2754) TeV picture.** Raby, S. (Stanford Univ., CA (USA)). Jun 1981. Contract AC03-76SF00515. 10p. (CONF-810485—3). NTIS, PC A02/MF A01. Order Number DE81030407.

From 2. workshop on grand unification; Ann Arbor, MI, USA (Apr 1981).

A not-so-standard model of strong and electroweak interactions is discussed. Some direct consequences of this model are discussed and finally the outlook for the future is considered.

# 65 PHYSICS RESEARCH

## 6510 Nuclear Physics

35628 **(LBL—13029) Relativistic heavy-ion experiments.** Pugh, H.G. (Lawrence Berkeley Lab., CA (USA)). Aug 1981. Contract W-7405-ENG-48. 30p. (CONF-8106157—1). NTIS, PC A02/MF A01. Order Number DE81030544.

From 12. international symposium on multiparticle dynamics; South Bend, IN, USA (21 Jun 1981).

Objectives of high energy nucleus-nucleus studies are outlined. Bevalac experiments on the formation of hot high-density equilibrated nuclear matter are discussed. Future programs are outlined, including research at the CERN ISR.

35629 **(ORNL/TM—7945) Representation of the neutron cross sections of several fertile and fissile nuclei in the resonance regions.** de Saussure, G.; Perez, R.B. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 42p. (ENDF—312). NTIS, PC A03/MF A01. Order Number DE82000504.

Several problems related to the measurement, analysis and evaluation of the neutron cross sections of the main fertile and fissile nuclides in the resonance region are reviewed. In particular, the ENDF/B-V representation of these cross sections are discussed. In recent years little progress has been made in improving knowledge of the resolved resonance parameters of the fertile nuclei. It is suggested that this absence of progress is due to a lack of adequate methodologies to deal with the systematic errors arising from uncertainties in the analysis of the measurements. The ENDF/B treatment of the unresolved resonance region is discussed, and the validation of the unresolved resonance range evaluations with appropriate transmission and selfindication measurements is recommended. 105 references.

## 6512 Nuclear Properties And Reactions, A=1-5

*REFER ALSO TO CITATION(S) 35656*

35630 **Electromagnetic disintegration of the A = 3 and A = 4 nuclei.** Gibson, B.F. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). *Nuclear Physics [Section] A ;* **353**: No. 1/2, 85-98(16 Feb 1981).

From 9. international conference on the few-body problem; Eugene, OR, USA (17 - 23 Aug 1980).

The photodisintegration and electrodisintegration of $^3$H, $^3$He, and $^4$He are reviewed within the context of Faddeev type formalisms. The 2-body and 3-body breakup of the trinucleons are compared. Emphasis is placed upon E1 numerical results, although threshold E0 electrodisintegration and thermal capture are discussed. Consideration of $^4$He disintegration is limited to the 2-body breakup channels.

## 6513 Nuclear Properties And Reactions, A=6-19

35631 **Continuum effects in pion-nucleus inelastic scattering.** Siciliano, E.R.; Weiss, D.L. (Los Alamos Scientific Lab., NM (USA)). *Physics Letters, [Section] B ;* **93**: No. 4, 371-375(Jun 1980).

An enhancement of the $\pi^-$ nuclear response over the $\pi^+$ is found for both the T = 0 and T = 1 'stretched' states of light even-even nuclei when continuum single-particle wave functions are used. Isospin-mixing between these states is discussed.

35632 **Intermediate-structure fusion resonances observed in the radiative capture of $^{12}$C by $^{12}$C.** Nathan, A.M.; Sandorfi, A.M.; Bowles, T.J. (University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 3, 932-943(Sep 1981).

We have investigated the $^{12}$C($^{12}$C,γ)$^{24}$Mg reaction, populating low-lying states of $^{24}$Mg, with $^{12}$C+$^{12}$C c.m. energies between 5 and 11 MeV. High energy γ rays were detected in a large volume NaI spectrometer which had sufficient resolution to distinguish clearly the $\gamma_0$, $\gamma_1$, and γ/sub 2,3/ transitions. Several resonances were observed in each of the decay channels. In particular, the $\gamma_0$ excitation function has four narrow resonances at E/sub c.m./ = 5.6, 6.0, 6.8, and 8.0 MeV, which are unambiguously assigned J/sup π/ = $2^+$. The upper three of these resonances are correlated in all three decay channels but are not correlated either with previously identified $2^+$ structures in the $^{12}$C+$^{12}$C system or with structure in the distribution of ground-state E2 strength in $^{24}$Mg. Furthermore, calculations demonstrate that these resonances have large nonstatistical $^{12}$C- and photon-partial widths. We argue that the data are suggestive of a new and unusual form of intermediate structure, namely highly clustered $^{12}$C+$^{12}$C configurations built on the ground-state band of $^{24}$Mg.

35633 **Fragmentation of $^{16}$O and $^{18}$O projectiles.** Tabor, S.L.; Dennis, L.C.; Kemper, K.W.; Fox, J.D.; Abdo, K.; Neuschaefer, G.; Kovar, D.G.; Ernst, H. (Department of Physics, Florida State University, Tallahassee, Florida 32306). *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 3, 960-965(Sep 1981).

The energy spectra of particles lighter than the beam have been measured following the bombardment of $^{12}$C, $^{27}$Al, and $^{46}$Ti targets with 72 MeV $^{16}$O beams and 72 and 141 MeV $^{18}$O beams. All the spectra exhibit broad continuum peaks centered at approximately the beam velocity. The shapes of these continuum structures are rather well reproduced by a fragmentation model which assumes that the unobserved fragment is transferred to the target and which contains no adjustable parameters. The $^{18}$O fragmentation spectra on the three targets are very similar in shape. The total yield of fragmentation products is about the same for the $^{16}$O and $^{18}$O beams at 72 MeV, although the Z distribution of strength differs. On the other hand, the fragmentation yield of $^{18}$O increases by a factor of 5 when the beam energy is raised from 72 to 141 MeV, but the relative Z distribution of strength remains constant.

35634 **Closure-approximation calculation of a pion double-charge-exchange reaction.** Li, G.L. (State Univ. of New York, Stony Brook (USA). Dept. of Physics; Academia Sinica, Beijing (China). Inst. of High Energy Physics); Li, C.H. (State Univ. of New York, Stony Brook (USA). Dept. of Physics; Academic Sinica, Beijing (China). Inst. of Atomic Energy); Lee, T.S.H. (State Univ. of New York, Stony Brook (USA). Dept. of Physics; Argonne National Lab., IL (USA)). *Physics Letters, [Section] B ;* **99**: No. 3, 200-204(19 Feb 1981).

A pion double-charge-exchange reaction is studied by using a closure approximation to sum the intermediate nuclear states. The calculated first minimum of the differential cross section of $^{18}O(\pi^+,\pi^-)^{18}Ne$ is at 30°, which is much smaller than the value of the optical-model calculation. However, the closure-approximation model cannot describe the data even when the polarization of the $^{16}O$ core is treated properly.

## 6514 Nuclear Properties And Reactions, A=20-38

*REFER ALSO TO CITATION(S) 35632, 35633*

35635 **Elastic and inelastic scattering studies for the systems $^{12}C+^{28}Si$ and $^{16}O+$/sup 28,29,30/Si.** Braun-Munzinger, P.; Berkowitz, G.M.; Gai, M.; Jachcinski, C.M.; Renner, T.R.; Uhlhorn, C.D.; Barrette, J.; LeVine, M.J. (Department of Physics, State University of New York, Stony Brook, New York 11794). *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 3, 1010-1022(Sep 1981).

Elastic and inelastic excitation functions for the systems $^{12}C+$ $^{28}$Si and $^{16}O+$/sup 28,29,30/Si have been measured at $\theta$/sub c.m./ = 180° from the Coulomb barrier up to E/sub c.m./ = 45 MeV ($^{12}C+^{28}Si$), E/sub c.m./ = 52 MeV ($^{16}O+^{28}Si$), and E/sub c.m./ = 32 MeV ($^{16}O+$/sup 29,30/Si). Over the whole energy range they all exhibit pronounced and regular broad oscillations (0.5< or ≈$\theta$< or ≈1.5 MeV). Elastic and inelastic angular distributions up to $\theta$/sub c.m./ = 180° were taken at five of the maxima and near a minimum of the excitation function for the system $^{16}O+^{28}Si$. All angular distributions are oscillatory and exhibit a strong backward rise. The data are discussed in terms of a coherent superposition of a background and a resonant amplitude and in terms of the interference between the internal and barrier wave reflected by a deep optical potential.

35636 **Intermediate structure resonances in $^{56}$Ni.** Betts, R.R.; Back, B.B.; Glagola, B.G. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Physical Review Letters ;* **47**: No. 1, 23-26(6 Jul 1981).

Detailed excitation functions of angle-integrated cross sections for $^{28}Si+^{28}Si$ elastic scattering and reactions show narrow, highly correlated structures. These resonances have enhanced partial widths for decay into two $^{28}$Si fragments and are interpreted as having quasimolecular or fission-isomeric nature.

35637 **Large angle scattering of $^{16}$O by $^{24}$sup(,) $^{25}$sup(,) $^{26}$Mg by detecting the heavy mass recoil.** Drake, D.M.; Moses, J.D.; Peng, J.C.; Stein, N.; Sunier, J.W. (Los Alamos Scientific Lab., NM (USA)). *Physics Letters, [Section] B ;* **100**: No. 3, 236-240(2 Apr 1981).

Large angle scattering of $^{16}$O by $^{24}$sup(,)$^{25}$sup(,)$^{26}$Mg has been observed by measuring the reactions $^{24}$sup(,)$^{25}$sup(,)$^{26}$Mg($^{16}$O, $^{24}$sup(,)$^{25}$sup(,)$^{26}$Mg)$^{16}$O in the forward direction. Although the cross section magnitudes for $^{24}$Mg are 5 to 10 times larger than for $^{25}$sup(,)$^{26}$Mg, excitation functions for all three elastic scattering reactions show similar resonance-like gross structure for incident energies between 45 and 59 MeV.

35638 **Absolute cross sections for the $^{27}$Al(p,3pn)$^{24}$Na reaction at 28 and 0.8 GeV.** Cumming, J.B.; Agoritsas, V.; Witkover, R. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Instruments and Methods ;* **180**: No. 1, 37-44(15 Feb 1981).

Absolute cross sections for the $^{27}$Al(p,3pn)$^{24}$Na reaction have been determined to be (7.92 +- 0.18) mb at 28 GeV and (10.94 +- 0.24) mb at 0.8 GeV. In this work, proton beam intensities in the AGS fast external beam were measured with current transformer and integrator systems which were calibrated electrically. The $^{24}$Na induced in aluminium foils was assayed by comparing the intensity of its 1368 keV gamma ray with that of the 1332 keV line from calibrated $^{60}$Co standards.

## 6515 Nuclear Properties And Reactions, A=39-58

*REFER ALSO TO CITATION(S) 35633*

35639 **Excitation functions of $^{16}$O inelastic scattering on $^{40}$Ca.** Kubono, S.; Bond, P.D.; Horn, D. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 3, 1340-1342(Sep 1981).

Excitation functions for inelastic scattering of $^{16}$O leading to the first $5^-$ state and $(2^+ +3^-)$ states in $^{40}$Ca have been measured at the first maxima of the angular distributions. A monotonic increase with bombarding energy is observed for these cross sections, with no indication of the oscillatory structure seen for the 180° elastic scattering excitation function.

## 6517 Nuclear Properties And Reactions, A=90-149

35640 **Proton hole states in neutron rich nuclei near A = 100.** Flynn, E.R.; Ajzenberg-Selove, F.; Brown, R.E.; Cizewski, J.A.; Sunier, J.W. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 3, 902-910(Sep 1981).

A study of proton hole states in neutron rich nuclei near A = 100 has been carried out using the (t,α) reaction. Targets of $^{104}$Ru and $^{110}$Pd were bombarded with a beam of 17 MeV polarized tritons and the reaction α particles detected in a quadrupole-three-dipole spectrometer. Only the β decays of the residual nuclei, $^{103}$Tc and $^{109}$Rh, have been previously observed. The results indicate a smooth trend with Z of the proton single particle states observed in this region, except for $^{103}$Tc. Examination of this nucleus indicates a strong tendency towards deformation.

35641 **Half-life of $^{148}$Gd.** Prestwood, R.J.; Curtis, D.B.; Cappis, J.H. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 3, 1346-1347(Sep 1981).

Gadolinium isotopes were separated from a tantalum target which had been irradiated with 800-MeV protons. The concentrations of $^{148}$Gd in weighed aliquots of a solution of the isotopes were determined by isotope dilution mass spectrometry. Other aliquots were counted on a low geometry alpha counter to determine the disintegration rate of $^{148}$Gd per unit weight of soulution. From the data obtained the half-life of the isotope was found to be 74.6 +- 3.0 yr.

35642 **πh$^3$sub(11/2) spectrum in the three valence proton nucleus $^{149}_{67}Ho_{82}$.** Wilson, J.; Faber, S.R.; Daly, P.J. (Purdue Univ., Lafayette, IN (USA). Dept. of Chemistry); Ahmad, I.; Borggreen, J.; Chowdhury, P.; Khoo, T.L.; Lawson, R.D.; Smither, R.K. (Argonne National Lab., IL (USA)); Blomqvist, J. (Forskningsinstitutet foer Atomfysik, Stockholm (Sweden)). *Zeitschrift fuer Physik [Sektion] A: Atoms and Nuclei ;* **296**: No. 2, 185-186(1980).

Short communication only.

## 6518 Nuclear Properties And Reactions, A=150-189

35643 **(ORNL/TM—7949) Neutron production by protons (190 to 268 MeV) in a water-cooled tantalum target.** Alsmiller, R.G. Jr.; Barish, J.; Barnes, J.M.; Santoro, R.T. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01. Order Number DE81030628.

Calculated results are presented for the number of neutrons produced, the neutron production spectra, and energy deposition as

a function of depth in the target when protons in the energy range 190 to 268 MeV are incident on a water-cooled tantalum target.

## 6519 Nuclear Properties And Reactions, A=190-219

*REFER ALSO TO CITATION(S) 35657*

35644 **(DOE/ER/10599—T1) Nuclear structure from radioactive decay. Annual progress report.** Wood, J.L. (Georgia Inst. of Tech., Atlanta (USA). School of Physics). 30 Sep 1981. Contract AS05-80ER10599. 13p. NTIS, PC A02/MF A01. Order Number DE82000423.

The major area of activity is the study of neutron-deficient nuclei around the Z = 82 shell closure, with special emphasis on the levels of the odd-mass Pt, Au, Hg and Tl isotopes. A crucial ingredient of this work is the systematic investigation of low-energy structural features of sequences of isotopes (and isotones) over many adjacent mass numbers. This has a two-fold purpose. First, it enables us to build up a very complete picture of nuclear structure that connects the regions of stable nuclei (where, e.g., transfer reactions and Coulomb excitation permit the measurement of detailed spectroscopic properties) with regions far from stability, where detailed spectroscopic information is very limited. Second, it provides a map of the excitation degrees of freedom as a function of the changing proton and neutron number over broad mass regions. Progress is reported. (WHK)

35645 **Search for isobaric analogues of M1 states and giant spinflip resonances in the $^{208}$Pb(p,n) reaction.** Horen, D.J.; Goodman, C.D. (Oak Ridge National Lab., TN (USA)); Foster, C.C. (Indiana Univ., Bloomington (USA)); Goulding, C.A.; Greenfield, M.B. (Florida Agricultural and Mechanical Univ., Tallahassee (USA)); Rapaport, J. (Ohio Univ., Athens (USA)); Bainum, D.E. (Emporia State Univ., KS (USA)); Sugarbaker, E.; Masterson, T.G. (Colorado Univ., Boulder (USA)); Petrovich, F. (Florida State Univ., Tallahassee (USA)). *Physics Letters, [Section] B ;* **95**: No. 1, 27-30(Sep 1980).

The $^{208}$Pb(p,n)$^{208}$Bi reaction has been studied at Esub(p) = 120 and 160 MeV. The GT resonance is found to be concentrated in disagreement with a recent theoretical suggestion that it is highly fragmented in heavy nuclei, but in good agreement with an earlier calculation. A giant $\Delta I = 1$, $\Delta S = 1$ resonance is also observed.

## 6520 Nuclear Properties And Reactions, A=220 And Above

*REFER ALSO TO CITATION(S) 34794*

35646 **(CONF-810957—1) Comparison of the ENDF/B-V and SOKRATOR evaluations of $^{235}$U, $^{239}$Pu, $^{240}$Pu and $^{241}$Pu at low neutron energies.** de Saussure, G.; Wright, R.Q. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 40p. NTIS, PC A03/MF A01. Order Number DE81032037.

From Joint IAEA/NEA consultants meeting on uranium and plutonium resonance parameters; Vienna, Austria (28 Sep 1981).

The US and USSR's most recent evaluationsof $^{235}$U, $^{239}$Pu, $^{240}$Pu and $^{241}$Pu are compared over the thermal region and over the first few resonances. The two evaluations rest on essentially the same experimental data base and the differences reflect different approaches to the representation of the cross sections or different weightings of the experimental results. It is found that over the thermal and resolved ranges the two evaluations are very similar. Some differences in approaches are briefly discussed.

35647 **(UCRL—85325) Neutron capture gamma-ray spectroscopic measurements in the actinide region.** Hoff, R.W.; Lougheed, R.W.; Barreau, G.; Boerner, H.; Davidson, W.F.; Schreckenbach, K.; Warner, D.D.; von Egidy, T.; White, D.H. (Lawrence Livermore National Lab., CA (USA); Institut Max von Laue - Paul Langevin, 38 - Grenoble (France); Western Oregon State Coll., Monmouth (USA)). Sep 1981. Contract W-7405-ENG-48. 15p. (CONF-810920—14). NTIS, PC A02/MF A01. Order Number DE81030316.

From 4. international symposium on neutron-capture gamma-ray spectroscopy and related topics; Grenoble, France (7 Sep 1981).

From recent neutron capture gamma-ray measurements, experimental data for states involving quasiparticle-vibrational admixtures in $^{227}$Ra, $^{231}$Th, $^{233}$Th, $^{235}$U, $^{237}$U, and $^{239}$U have been compared with theoretical calculations by Soloviev's group. This analysis shows the experimental level structure is more complex than that calculated. In the levels of $^{250}$Bk, four Gallagher-Moszkowski pairs are observed. The moment of inertia for each band with antiparallel alignment of odd-nucleon momenta is systematically larger than for its parallel-aligned mate.

35648 **(UCRL—86268) Excited levels of $^{238}$Np from spectroscopic measurements of the $^{237}$Np(n,$\gamma$)$^{238}$Np reaction and /sup 242m/Am alpha decay.** Hoff, R.; Ruhter, W.; Mann, L. (Lawrence Livermore National Lab., CA (USA); Fribourg Univ. (Switzerland); Institut Max von Laue - Paul Langevin, 38 - Grenoble (France)). Jun 1981. Contract W-7405-ENG-48. 5p. (CONF-810920—15). NTIS, PC A02/MF A01. Order Number DE81030477.

From 4. international symposium on neutron-capture gamma-ray spectroscopy and related topics; Grenoble, France (7 Sep 1981).

The gamma rays and conversion electrons emitted following neutron capture in a $^{237}$Np target have been measured by use of the GAMS and BILL spectrometers at Grenoble. Gamma ray and alpha particle measurements of /sup 242m/Am alpha decay (Ge(Li)$\gamma$ singles, $\gamma$-$\gamma$ coincidences, $\alpha$ singles) have been made at Livermore. The data from these measurements have been combined with earlier measurements (Ionescu 1979, Asaro 1964) to produce a more detailed level scheme for $^{238}$Np. Approximately 36 levels have been identified from all of the experimental evidence. The experimentally-observed bandhead energies can be compared with predicted values derived from a simple linear addition of excitation energies observed in neighboring odd-mass nuclei. Values for the Gallagher-Moszkowski splitting of each configurational pair were obtained from theoretical calculations (Piepenbring 1978). We have assigned configurations to ten rotational bands whose bandhead energies range from 0 to 342 keV and which represent all but one of the configurations predicted to occur below 385 keV.

35649 **E1 transition probabilities from K/sup $\pi$/ = 0$^-$ and K/sup $\pi$/ = 1$^-$ states of $^{238}$Pu.** Lederer, C.M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). W-7405-ENG-48. *Physical Review [Section] C: Nuclear Physics ;* **24**: No. 3, 1175-1185(Sep 1981).

Levels of $^{238}$Pu were studied in the $\beta^-$ decay of $^{238}$Np and the $\alpha$ decay of $^{242}$Cm. Thirteen $\gamma$-ray transitions were observed for the first time, and additional information about multipolarities and mixing ratios was obtained. An analysis of the $\gamma$-ray branching ratios gives a measure of the E1 transition probabilities between octupole-vibrational states and the ground-state band, corresponding to F/sub W/ = 4.3 x 10$^4$ for $\Delta K = 1$ transitions and F/sub W/ = 1.5 x 10$^4$ for $\Delta K = 0$. The latter transitions are three orders of magnitude faster than those that occur in the isotone $^{236}$U, for which F/sub W/($\Delta K = 0$) = 2.2 x 10$^7$, from a direct measurement of the half-life of the 0,1$^-$ state. Estimates of the hindrance factors for E1 transitions from octupole states in other heavy nuclei are given, and the validity of the calculations on which they are based is discussed.

35650 **Mass distribution for thermal-neutron-induced fission of $^{229}$Th.** Gindler, J.E.; Glendenin, L.E.; Henderson, D.J. (Argonne National Lab., IL (USA)). *Journal of Inorganic and Nuclear Chemistry ;* **43**: No. 7, 1433-1437(1981).

The yields of 36 fission products were determined either by radiochemistry or γ-ray spectrometry in the $^{229}$Th (nsub(th),f) reaction. The yields indicate considerable fine structure in the asymmetric peaks of the mass distribution and a small peak in the region of mass symmetry. The present yields are compared with those of previous works and a composite mass distribution is deduced. Characteristics of the distribution are the mean light mass, 87.90 +- 0.11; mean heavy mass, 140.08 +- 0.07; average number of neutrons emitted per fission, 2.02 +- 0.13; and peak-to-valley ratio ($^{144}$Ce/$^{115}$Cd), 438 +- 46.

## 6530 Nuclear Theory

*REFER ALSO TO CITATION(S) 35635*

**35651 Properties of nuclei at very high spin.** Stephens, F.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nuclear Physics* [*Section*] *A ;* **354**: No. 1/2, 289-302(23 Feb 1981).

From International conference on nuclear physics (ICNP '80); Berkeley, CA, USA (24 - 30 Aug 1980).

Nuclear structure at very high spins involves an interplay between collective (often rotational) and noncollective (individual particle alignment) behavior. The new techniques for studying γ-ray energy correlations promise to give detailed information about both of these aspects of nuclear behavior up to the very highest spins that can be populated.

**35652 Adiabatic description of dissipative processes in heavy-ion reactions and fission. II. Weak versus strong coupling and the role of the collective velocity.** Nemes, M.C.; Weidenmueller, H.A. (Max-Planck-Institut fuer Kernphysik, Heidelberg, West Germany). DE-AC02-76ER0-3069. *Physical Review* [*Section*] *C: Nuclear Physics ;* **24**: No. 3, 944-953(Sep 1981).

We investigate the friction and diffusion coefficients for a collective variable (nuclear shape degree of freedom, treated classically) coupled with other (intrinsic) degrees of freedom. An adiabatic representation for the intrinsic degrees of freedom is used. The results are remarkably different from those given by linear response theory: the lowest order nonvanishing contribution to the friction coefficient is proportional to $Q^3$. The physical origin of this behavior is discussed as well as the limits of validity of weak and strong coupling regimes, and their applicability to fission and deep inelastic scattering.

**35653 Mean-field study of the nuclear partition function: application to level density and compound nucleus fission.** Kerman, A.K.; Levit, S. (Center for Theoretical Physics Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). DE-AC02-76ER0-3069. *Physical Review* [*Section*] *C: Nuclear Physics ;* **24**: No. 3, 1029-1046(Sep 1981).

Functional integral formulation of the mean-field approximation for many-body systems is used to study the nuclear partition function. Both static and dynamic mean-field solutions with statistical occupations of the single particle wave functions are discussed. These correspond to different physical processes in the nuclear system. In the static case the effect of mean-field fluctuations on the nuclear level density is exhibited. This effect enters consistently along with the usual effects of temperature and chemical potential fluctuations. Together they account for generalized random phase approximation correlations and produce bosonlike terms in the nuclear entropy. Because of the self-consistency of the approach, no overcounting of the collective and single-particle degrees of freedom occurs. The effects of the single particle continuum are included in the discussion. In the low temperature limit a simple correction to the level density parameter is evaluated, which leads to an increase of its magnitude. Consequences of a possible multiplicity of static mean-field configurations are briefly discussed. Dynamical mean-field solutions are considered in relation to compound nucleus fission. They provide the extension of the mean-field description of spontaneous fission given recently. A microscopic expression for the energy dependence of the average fission width is presented. It combines both the dynamical and statistical features of the tunneling mean-field solution in the subbarrier region.

**35654 Effective nucleon-nucleon interaction for scattering at intermediate energies.** Love, W.G.; Franey, M.A. (Department of Physics and Astronomy, University of Georgia, Athens, Georgia 30602). *Physical Review* [*Section*] *C: Nuclear Physics ;* **24**: No. 3, 1073-1094(Sep 1981).

A local representation of the free nucleon-nucleon t matrix has been determined for several projectile bombarding energies between 100 and 800 MeV/nucleon and is presented in tabular form. The form of the interaction has been tailored for use in calculations of elastic and inelastic proton scattering in this energy range. The technique used to derive the interaction is outlined and some of the resulting uncertainties are discussed. A number of the most important properties of the interaction and their roles in the calculation of nucleon-nucleus scattering observables are discussed. A few applications of the interaction are made to a variety of ( p,p') transitions within a single-scattering context.

**35655 Three-body correlations in nuclear matter.** Day, B.D. (Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Physical Review* [*Section*] *C: Nuclear Physics ;* **24**: No. 3, 1203-1271(Sep 1981).

A momentum-space method is developed for the calculation of three-body terms in the Brueckner-Bethe method for nuclear matter. The method is similar to one used earlier for central S-wave potentials. Here we extend it to the full nuclear force, including tensor forces, spin-orbit forces, etc. Furthermore, we show how the method can be used to investigate the possibility of long-range correlations in nuclear matter by summing the generalized ring series. The numerical accuracy obtainable with various mesh parameters and cutoffs in momentum space, and with various truncations of partial-wave expansions, is thoroughly explored. Several angle-average approximations are used, and the estimated numerical accuracy in the three-body cluster energy is 10 —15 %. The method is applied to a central potential $v_2$, a semirealistic potential $v_6$(Reid), which has a tensor force, and to the Reid potential, augmented by an interaction that is consistent with empirical scattering phase shifts in two-body partial waves with j> or =3. In all cases the three-body contribution to the energy is correctly given in order of magnitude by $\kappa_2 D_2$, where $D_2$ is the two-body contribution and $\kappa_2$ is the usual convergence parameter of the Brueckner-Bethe method. The generalized ring series is found to converge rapidly, indicating that long-range correlations are not very important for the binding energy of nuclear matter. The Reid potential is found to saturate at the right energy but at too high a density.

**35656 Approximate Coulomb effects in the three-body scattering problem.** Haftel, M.I.; Zankel, H. (Naval Research Laboratory, Washington, D.C. 20375). *Physical Review* [*Section*] *C: Nuclear Physics ;* **24**: No. 3, 1322-1335(Sep 1981).

From the momentum space Faddeev equations we derive approximate expressions which describe the Coulomb-nuclear interference in the three-body elastic scattering, rearrangement, and breakup problems and apply the formalism to p-d elastic scattering. The approximations treat the Coulomb interference as mainly a two-body effect, but we allow for the charge distribution of the deuteron in the p-d calculations. Real and imaginary parts of the Coulomb correction to the elastic scattering phase shifts are described in terms of on-shell quantities only. In the case of pure Coulomb breakup we recover the distorted-wave Born approximation result. Comparing the derived approximation with the full Faddeev p-d elastic scattering calculation, which includes the Coulomb force, we obtain good qualitative agreement in S and P waves, but disagreement in repulsive higher partial waves. The on-shell approximation investigated is found to be superior to other current approximations. The calculated differential cross sections at 10 MeV raise the question of whether there is a significant Coulomb-nuclear interference at backward angles.

**35657 U(6/4) dynamical supersymmetry in nuclei.** Balantekin, A.B.; Bars, I.; Iachello, F. (Physics Department, Yale University, New Haven, Connecticut 06520). EY-76-C-02-3074;EY-76-C-02-3075;DE-AC02-76-ER-03074. *Physical Review Letters ;* **47**: No. 1, 19-23(6 Jul 1981).

We suggest that a supersymmetry scheme based on the supergroup U(6/4) may be useful in describing many properties of nuclei in the Os-Pt region. The bosons and fermions in the fundamental representation of U(6/4) are the low-lying collective (bosonic) and single-particle (fermionic) degrees of freedom. Experimental evidence indicates that the scheme applies to several nuclei in the region within roughly-equal30%. This appears to be the first observed example of a supersymmetry.

35658 **Fusion barriers, empirical and theoretical: Evidence for dynamic deformation in subbarrier fusion.** Vaz, L.C.; Alexander, J.M. (State Univ. of New York, Stony Brook (USA). Dept. of Chemistry); Satchler, G.R. (Oak Ridge National Lab., TN (USA)). *Physics Reports: A Review Section of Physics Letters (Section C)* ; **69**: No. 5, 373-399(Apr 1981).

Semiempirical fusion barriers have been obtained by analysis of 87 excitation functions for complete fusion. These barriers are used as a test for several theoretical potentials. For most of the reactions at energies below the operational s-wave fusion barrier, the cross sections are greater than expected from considerations of simple barrier penetration alone. We ascribe this to dynamic effects, such as neck formation which may be expected as precursors of fusion. The effects of static deformation do not appear to be sufficient to explain the discrepancies.

35659 **Synthesis of quantum chromodynamics and nuclear physics.** Brodsky, S.J. (Stanford Linear Accelerator Center, CA (USA)); Lepage, G.P. (Cornell Univ., Ithaca, NY (USA). Lab. of Nuclear Studies). *Nuclear Physics [Section] A* ; **353**: No. 1/2, 247-256(16 Feb 1981).

From 9. international conference on the few-body problem; Eugene, OR, USA (17 - 23 Aug 1980).

The asymptotic freedom behavior of quantum chromodynamics allows the rigorous calculation of hadronic and nuclear amplitudes at short distances using perturbative methods. The implications of QCD for large momentum transfer nuclear form factors and scattering processes, as well as for the structure of nuclear wavefunctions and nuclear interactions at short distances are discussed. The necessity for color-polarized internal nuclear states are also discussed.

## 6540 Radiation And Shielding Physics

35660 **(RFP-Trans—297) Magnesium hydroxide neutron-shielding material and method of producing such material.** Aoki, S.; Asami, H.; Takeshige, I. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 2 Mar 1978. Translation of Japanese Patent 1978-53-22998. 10p. NTIS, PC A02/MF A01. Order Number DE81030298.

A method for producing neutron-shielding material consisting of formed magnesium hydroxide having a very high density of hydrogen atoms (hydrogen concentration) is described. Such material is very effective for moderation and absorption of fast neutrons. (WHK)

## 6550 Medical Physics

*REFER ALSO TO CITATION(S) 35447, 35496*

35661 **(ORNL/RSIC—45) Specific gamma-ray dose constants for nuclides important to dosimetry and radiological assessment.** Unger, L.M.; Trubey, D.K. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 76p. NTIS, PC A05/MF A01. Order Number DE81031980.

Tables of specific gamma-ray dose constants (the unshielded gamma-ray dose equivalent rate at 1 m from a point source) have been computed for approximately 500 nuclides important to dosimetry and radiological assessment. The half life, the mean attenuation coefficient, and thickness for a lead shield providing 95% dose equivalent attenuation are also listed.

## 6560 Solid State Physics

*REFER ALSO TO CITATION(S) 35220, 35221*

35662 **(BNL—29957) Observing solitons in one dimensional magnetic systems.** Reiter, G. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 10p. (CONF-810840—5). NTIS, PC A02/MF A01. Order Number DE81029919.

From Symposium on neutron scattering; Argonne, IL, USA (12 Aug 1981).

Classical models of one dimensional magnetic systems show that in addition to the linear spin wave excitations, there should exist localized, large amplitude excitations, that can move along the chains while retaining their integrity. It is expected that these excitations, solitons, exist in real materials. The progress that has been made to date in observing solitons in one dimensional magnets by means of neutron scattering, and the difficulties that still remain in unambiguously identifying the soliton contributions to $S(q,\omega)$ are discussed.

35663 **(DOE/ER/03158—98) Point-defect sources and sinks.** Seidman, D.N. (Cornell Univ., Ithaca, NY (USA)). Aug 1981. Contract AS02-76ER03158. 9p. NTIS, PC A02/MF A01. Order Number DE82000655.

The role played by sources and sinks of point defects is of importance in understanding a wide range of physical phenomena. The problem of the efficiency (eta) of a sink (or sources) and its relationship to the super (or sub) saturation of point defects which drives the process is considered. A qualitative discussion is given of the atomic mechanisms by which the following defects act as sources and sinks: (a) the free surface; (b) voids; (c) dislocation loops; and (d) grain boundaries. Examples of specific values of eta are given for different experimental situations.

35664 (LBL—12000, pp 139-182) **Solid-state physics.** Richards, P.L. Jun 1981. NTIS, PC A24/MF A01. Order Number DE81027828.

In Materials and Molecular Research Division annual report 1980.

Research areas reported include: far-infrared spectroscopy; experimental solid state physics and quantum electronics; excited quantum fluids in solids; superconductivity, superconducting devices and 1/f noise; theoretical studies of the electronic properties of solid surfaces; and theoretical solid state physics. (GHT)

35665 **(UCRL—85576) Study of shock-induced signals and coherent effects in solids by molecular dynamics.** Karo, A.M.; Walker, F.E.; Cunningham, W.G.; Hardy, J.R. (Lawrence Livermore National Lab., CA (USA); Nebraska Univ., Lincoln (USA). Behlen Lab. of Physics). 31 Aug 1981. Contract W-7405-ENG-48. 22p. (CONF-810874—1). NTIS, PC A02/MF A01. Order Number DE81030412.

From 8. international colloquium on gasdynamics of explosions and reactive systems; Minsk, USSR (23 Aug 1981).

Molecular dynamics calculations are presented that address the extent of microscopic detail that can be deduced from macroscopic gauge measurements of shock propagation in condensed systems. We have simulated large asymmetrically shock-loaded lattices, varying the initial temperature of both the loading plates and the lattice. Specifically: we have studied triple shock loading of a thin lattice; double shock loading of the same lattice; and triple shock loading of a thick lattice. In all cases we found strong memory effects in that the spall pattern always mirrors the loading history. This is a direct consequence of our two basic results: (a) the energy in finite width shocks is only weakly coupled to motions transverse to their direction of propagation; and (b) coupling between shock motion and random thermal motion is relatively weak, even in lattices that are near their melting temperatures.

35666 **Cubic-tetragonal elastic phase transformations in solids.** Axe, J.D.; Yamada, Y. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter* ; **24**: No. 5, 2567-2569(1 Sep 1981).

The cubic-tetragonal transformation driven by the elastic instability ($C_{11}$-$C_{12}$)→0 may be followed by further rearrangements in which c/a>1 changes to c/a<1 or vice versa. These transformations are investigated by Landau theory. Unlike the cubic-tetragonal transformation, which must be first order, the subsequent reordering may be either a single first-order transformation or involve two second-order transformations through an intervening orthorhombic phase. The three-phase boundaries terminate in a bicritical point. Examples of both types of behavior are discussed briefly.

35667 **Phase diagram of the Potts model in an applied field.** Goldschmidt, Y.Y. (Department of Physics, Brown University, Providence, Rhode Island 02912). DE-AC02-76ER03130.A006. *Physical Review [Section] B: Condensed Matter ;* **24**: No. 3, 1374-1383(1 Aug 1981).

We use the technique of large-q expansion to investigate the phase diagram of the q-state Potts model in an applied field favoring order in one state. The method is valid for any number of dimensions. We find that for q>q/sub C/ (d) there is a first-order phase boundary starting at the zero-field transition point and terminating in a critical point in the interior of the hT plane. Using Pade approximants we obtain for d = 2 the shape and location of this line for various values of q. We also develop a lattice-gas expansion for any d which enables us, in the limit of large but finite q, to map the problem into an equivalent Ising expansion and thus find the exact location and nature of the critical point in this limit.

## 6561 Superconductivity

*REFER ALSO TO CITATION(S) 35196, 35199, 35664*

35668 **(SAND—81-1115C) Low-temperature electron spin resonance in $(TMTSF)_2PF_6$ in the high-pressure metallic phase.** Azevedo, L.J.; Schirber, J.E.; Greene, R.L.; Engler, E.M. (Sandia National Labs., Albuquerque, NM (USA); International Business Machines Corp., San Jose, CA (USA). Research Lab.). 1981. Contract AC04-76DP00789. 12p. (CONF-810864—2). NTIS, PC A02/MF A01. Order Number DE81030233.

From International conference on low-dimensional conductors; Boulder, CO, USA (10 Aug 1981).

The electron spin resonance of $(TMTSF)_2PF_6$ has been observed at low fields ($H_0 < 110$ Oe) in the high pressure, metallic phase ($p \geq 6.5$ kbar) in the temperature range 1 to 4 °K. The anisotropy in the g value is similar to that observed at ambient pressure above the metal-insulator transition. The linewidth is very narrow and the spin susceptibility strongly decreases as the superconducting transition is approached from above. This is interpreted as evidence for singlet-paired superconductivity. Superconductivity is observed at 1.1°K and the critical field has angular dependence in the bc plane. These observations lead us to conclude that $(TMTSF)_2PF_6$ is a singlet paired superconductor.

35669 **Uniaxial type-II superconductors near the upper critical field.** Kogan, V.G.; Clem, J.R. (Ames Laboratory: U.S. Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). W-7405-ENG-82;WPAS-KC-02-02-03. *Physical Review [Section] B: Condensed Matter ;* **24**: No. 5, 2497-2505(1 Sep 1981).

The problem of a uniaxial type-II superconductor near the upper critical field is considered in the framework of the Ginzburg-Landau equations with a phenomenological mass tensor. The currents are shown to flow in planes which are in general no longer orthogonal to the direction of the vortex axes as in the isotropic case; the inclination angle is obtained in terms of anisotropic masses. The magnetic field has a component normal to the vortex axes; equations are derived which relate the transverse and axial fields. The average value of the transverse field (the transverse induction) vanishes. The constitutive relation between the induction and the magnetization is obtained. The components of the magnetization normal and parallel to the vortex direction are simply related in terms of the effective masses.

35670 **Characterization of type-II superconductor via synthesis of observed induced-voltage waveforms.** Griffths, D.J.; Kroeger, D.M. (Department of Physics, Oregon State University Corvallis, Oregon 97331). *Journal of Applied Physics ;* **52**: No. 9, 5744-5750(Sep 1981).

Induced-voltage waveforms exhibited by type-II superconductors in response to a time varying magnetic field superimposed on a steady dc magnetic field have been compared to those calculated using a modification of a computer program developed by Rouze and Clem. This program allows a choice for the magnetic field dependence of critical current density, equilibrium magnetization, flux entry, and exit barriers as well as the specific from of the time-dependent magnetic field. Once agreement between predicted and observed waveforms has been achieved the separation of ac losses into pinning and annihilation contributions, their dependence on both dc bias field and time varying field amplitude as well as their spatial variation within the superconductor can be determined. We find reasonable agreement between a specific critical-state model collections of J/sub c/(B),H/sub e/q(B), H/sub e/n(B), H/sub e/x(B), and experimental results in the case of Nb:38% Hf.

35671 **London approach to anisotropic type-II superconductors.** Kogan, V.G. (Ames Laboratory-U.S. Department of Energy and Department of Physics, Iowa State University, Ames, Iowa, 50011). W-7405-ENG-82; WPAS-KC-02-02-03. *Physical Review [Section] B: Condensed Matter ;* **24**: No. 3, 1572-1575(1 Aug 1981).

The London equations with a phenomenlogical mass tensor are used to analyze the vortex structure near the lower critical field. The anisotropy results in a transverse magnetic field in the Abrikosov vortex. This field attenuates exponentially at large distances from the vortex axis. The strongly anisotropic attenuation length is evaluated. The line energy is found in the London approximation.

## 6570 Theoretical Physics

*REFER ALSO TO CITATION(S) 35765*

35672 **(ORNL/CSD—84) Quasi-stationary approximation for the Stefan problem with a convective boundary condition.** Solomon, A.D.; Wilson, D.G.; Alexiades, V. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 40p. NTIS, PC A03/MF A01. Order Number DE81030372.

It is shown the solution to the Stefan problem with a convective boundary condition tends to the quasi-stationary approximation as the specific heat tends to zero. Additional properties of the approximation are given, and some examples are presented.

35673 **Representations of a local current algebra in nonsimply connected space and the Aharonov—Bohm effect.** Goldin, G.A.; Menikoff, R.; Sharp, D.H. (Department of Mathematical Sciences, Northern Illinois University, DeKalb, Illinois, 60115 and Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Journal of Mathematical Physics (New York) ;* **22**: No. 8, 1664-1668(Aug 1981).

A recent paper established technical conditions for the construction of a class of induced representations of the nonrelativistic current group SAK, where S is Schwartz's space of rapidly decreasing C/sup infinity/ functions, and K is a group of C/sup infinity/ diffeomorphisms of R/sup s/. Bose and Fermi N-particle systems were recovered as unitarily inequivalent induced representations of the group by lifting the action of K on an orbit $\Delta \subset S'$ to its universal covering space Delta-tilde. For s> or =3, Delta-tilde is the coordinate space for N particles, which is simply connected. In two-dimensional space, however, the coordinate space is multiply connected, implying induced representations other than those describing the usual Bose or Fermi statistics; these are explored in the present paper. Likewise the Aharonov—Bohm effect is described by means of induced representations of the local observables, defined in a nonsimply connected region of R/sup s/. The vector potential plays no role in this description of the Aharonov—Bohm effect.

35674 **Mathematical structure of arrangement channel quantum mechanics.** Evans, J.W. (Ames Laboratory and Department of Chemistry, Iowa State University, Ames, Iowa 50011). W-7405-ENG-82,. *Journal of Mathematical Physics (New York)* ; **22**: No. 8, 1672-1686(Aug 1981).

A non-Hermitian matrix Hamiltonian H appears in the wavefunction form of a variety of many-body scattering theories. This operator acts on an arrangement channel Banach or Hilbert space C = direct-sum/sub α/H where H is the N-particle Hilbert space and α are certain arrangement channels. Various aspects of the spectral and semigroup theory for H are considered. The normalizable and weak (wavelike) eigenvectors of H are naturally characterized as either physical or spurious. Typically H is scalar spectral and "equivalent" to H on an H-invariant subspace of physical solutions. If the eigenvectors form a basis, by constructing a suitable biorthogonal system, we show that H is scalar spectral on C. Other concepts including the channel space observables, trace class and trace, density matrix and Moeller operators are developed. The sense in which the theory provides a "representation" of N-particle quantum mechanics and its equivalence to the usual Hilbert space theory is clarified.

35675 **Restrictions on relativistically rotating fluids.** Schendel, J.; Winicour, J. (Department of Physics and Astronomy, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). *Journal of Mathematical Physics (New York)* ; **22**: No. 8, 1696-1702(Aug 1981).

We develop an extensive set of inequalities which apply to the surface of a relativistically rotating fluid with asymptotically flat exterior. We explore the physical content of these inequalities by examining the restrictions they impose on the existence of rotating fluid models with Kerr exteriors. In that case, the dominant set of inequalities can be expressed in a simple analytic form. We find for all models with Kerr parameter a>m that there is a finite maximum redshift between observers at the fluid surface and at infinity. However, for all models with 0<a/m< or =1 there is no upper bound to the redshift. In the static limit, as a/m→0, a finite redshift maximum emerges in a discontinuous manner. The value of this maximum depends upon the moment of inertia of the static background fluid. We discuss the implications toward the possibility of a high redshift quasar model.

# 70 FUSION ENERGY

*REFER ALSO TO CITATION(S) 34416*

## 7001 Plasma Research

*REFER ALSO TO CITATION(S) 35741*

35676 **(BNL—29948) Search for promethium-like gold lines and other transitions of interest to fusion research.** Johnson, B.M.; Jones, K.W.; Kruse, T.H.; Curtis, L.J.; Ellis, D.G. (Brookhaven National Lab., Upton, NY (USA); Rutgers--the State Univ., Piscataway, NJ (USA); Toledo Univ., OH (USA)). 1981. Contract AC02-76CH00016. 20p. (CONF-810868—2). NTIS, PC A02/MF A01. Order Number DE81029917.

From 6. international conference on fast ion beam spectroscopy; Quebec, Canada (17 Aug 1981).

EUV spectra in the range λ = 13 to 40 rm were measured for foil-excited gold ions at 31 to 238 MeV. Data was recorded at the higher energies to extend and to complement previous measurements and at the lowest energy to see if the recently predicted 5s - 5p resonance lines in the Pm-like ion, Au XIX, could be seen in beam-foil excitation. The experimental results are presented, previous beam-foil measurements are reviewed, and the contributions and relations to fusion research are discussed.

35677 **(CONF-810511—) Ambipolar potential formation and control in bumpy tori and mirrors.** Uckan, N.A. (ed.). (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 459p. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

Separate abstracts were prepared for 19 of the included papers. Some of the included papers appeared earlier in ERA. A title listing only is given for three of the papers since only an abstract is given in the conference proceedings. (MOW)

35678 (CONF-810511—, pp 23-35) **Multi-species ambipolar phenomena in the Elmo Bumpy Torus.** Guest, G.E. (Applied Microwave Plasma Concepts, Encinitis, CA). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

An earlier, heuristic version of neoclassical transport theory suggested a plausible interpretation of empirical results from EBT-I, such as the relation between electron temperature and density, the ambipolar electric field, and the distribution of ion energies in a two-species plasma consisting of equal concentrations of electrons and protons. This picture is easily generalized to include more than one species of ions, a situation which may arise experimentally by virtue of impurities or deliberate admixture of gases. Here we discuss the limiting case of a small relative concentration of a second species of ions and illustrate the results with plasma parameters typical of EBT-I/X. The dominant transport process for the trace ion group is assumed to be the rapid drift surface diffusion that results if the ion energy approaches the transitional energy, at which the net azimuthal drift velocity vanishes, W/sub t/ ≃ qE/sub r/R/sub c/.

35679 (CONF-810511—, pp 37-60) **Experimental measurement of plasma space potential.** Hickok, R.L. (Rensselaer Polytechnic Inst., Troy, NY). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

Basically two techniques have been used to measure plasma space potential. End loss analyzers have been used to measure the potential in open ended systems and heavy ion beam probes have been used to measure the potential in the central cell of TMX and on EBT-1/S. A brief discussion of both is given.

35680 (CONF-810511—, pp 85-103) **Space potential measurements in the central cell of TMX.** Hallock, G.A.; Hickok, R.L.; Hornady, R.S.; Jennings, W.C.; Saadatmand, K. (Rensselaer Polytechnic Inst., Troy, NY). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

A heavy ion beam probe has provided detailed spatial and temporal measurements of the central cell space potential (phi/sub e/). With gas box fueling of the plasma at typical feed rates (~ 1200 atom-amps) the potential is strongly parabolic to at least 25 cm (r/sub limiter/ = 38 cm), with phi = phi/sub max/ (1 - (r/32cm)²) providing a good fit and 300 < phi/sub max/ < 450 volts depending on machine conditions such as neutral beam heating current, etc. With puffer fueling the central cell potential remains relatively flat to at least 30 cm.

35681 (CONF-810511—, pp 105-122) **Potential measurements in Phaedrus: Wisconsin's Tandem Mirror.** Breun, R.A. (Univ. of Wisconsin, Madison). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

First, axial and radial potential measurements made on an afterglow plasma generated by on-axis stream guns, plug ICRH, and central cell gas puffing in the Phaedrus Tandem Mirror will be described. For this mode, the RF and stream guns are turned off at the same time. Secondly, initial potential and plasma parameter measurements on a unique mode of operation we call the RF sustained mode will be illustrated. Here, the ICRH in the plugs is left

on after gun turn-off and the plug density and diamagnetism is sustained for up to 1 ms (e - folding time). A near tandam mirror configuration is maintained without neutral beams.

35682 (CONF-810511—, pp 125-154) **Space potential measurements on EBT.** Connor, K.A.; Solensten, L.; Bieniosek, F.M.; Hickok, R.L. (Rensselaer Polytechnic Inst., Troy, NY). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

The most important characteristics of EBT-I operation are described. Most data have been taken under these conditions with the result that measurement errors are as stated above and well understood. EBT-S data are described for which accuracy is not as good. However, the basic features of EBT-I data are observed.

35683 (CONF-810511—, pp 155-166) **Potential formation in Nagoya Bumpy Torus.** Iguchi, H. (Nagoya Univ., Japan); Bieniosek, F.M.; Takasugi, K. Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

Space potential profiles in Nagoya Bumpy Torus have been measured with a heavy ion beam probe. Potassium and rubidium ion beams of 1 to 50 $\mu$A over an energy range of 3 to 15 kV have been used to measure the potential with a spatial resolution of about 1 cm. Detected secondary $K^{++}$ and $Rb^{++}$ currents are on the order of 1 to 10 nA. Experiments have been performed at several different magnetic fields, especially at 1.8 kG (SR-mode) and 3.2 kG (FR-mode). Measurements in typical T-mode operation show a positive potential in the core plasma of about 200 V in both SR- and FR-modes. Varying the field correction loop current charges the core potential by +-50 V from its value for I/sub t/ $\cong$ 0 but the potential remains positive. The difference between the space potential and the floating potential measured by a Langmuir probe is 100 to 150 V, which is a few times the electron temperature of the core plasma. The effect on space potential of additional heating at 10.5 GHz is also investigated. Measurements of the plasma potential in the M-mode show that the potential oscillates on a time-scale of 6 to 10 msec over a range of several kilovolts and these oscillations are correlated with oscillations in <n/sub e/1>.

35684 (CONF-810511—, pp 167-181) **Aluminum impurity ions and the ambipolar potential in EBT.** Richards, R.K.; Jaeger, E.F. (Oak Ridge National Lab., TN). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

There is experimental evidence of a correlation between the electric potential and aluminum impurities in EBT. This correlation is observed in the relation between the temperature of the highest aluminum charge state and the potential well depth. The aluminum temperature is determined for each charge state by measuring the Doppler broadening of a characteristic spectral line. Temperatures as large as 650 eV have been found for $Al^{+3}$. Aluminum densities are derived by measuring the brightness of spectral lines with an absolutely calibrated spectrometer. Typical central values indicate n/sub Al//n/sub e/ $\sim 10^{-3}$. The particle confinement time for the aluminum ions is determined by comparing the ratios of aluminum ion densities. Values for the aluminum confinement times are smaller than the electron confinement time by several orders of magnitude (tau/sub Al/ $<$ 100 $\mu$s). This short lifetime suggests a large particle flux of aluminum and the formation of an ambipolar potential as a consequence.

35685 (CONF-810511—, pp 183-199) **EBT transport and ambipolar potential formation with rapid loss of high energy impurity ions.** Jaeger, E.F.; Richards, R.K.; Hedrick, C.L. (Oak Ridge National Lab., TN). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

Density profiles for neutral impurity atoms and impurity ions of a single charge state are calculated as functions of radius in a 1-1/2-D transport calculation for the EBT toroidal plasma. The ion tail is neglected along with the source of electron due to ionization of neutral impurity atoms. Ad hoc energies and transport rates are assumed for the impurity ions consistent with spectroscopic measurement. Ambipolar transport rates are rederived to include impurity transport in the flux of positive particles, and the electric field is computed self-consistently. Steady-state solutions show potential well depths on the order of the impurity ion temperature divided by its charge. Also, due to the large gyroradius of the impurity ions, viscosity limits shear in the poloidal drift velocity. Thus, potential profiles tend to be more parabolic, and the plasma rotates more nearly as a rigid body than would be expected from simple neoclassical theory with no impurities present.

35686 (CONF-810511—, pp 203) **Magnetic field error effects on the ambipolar potential in EBT.** Callen, J.D. (Oak Ridge National Lab., TN). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

35687 (CONF-810511—, pp 233-266) **Ambipolar potential and its effects on the confinement parameters of the EBT plasma.** Uckan, T.; Colchin, R.J.; Davis, W.A.; Haste, G.R.; Hillis, D.L.; Solensten, L. (Oak Ridge National Lab., TN). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

In the ELMO Bumpy Torus (EBT), the plasma parameters depend on the microwave heating power P/sub $\mu$/ and on the neutral gas pressure p/sub o/, both of which define the operating regime (mode) of the device. In order to assess interrelationships between various confinement parameters, we have studied radial transport by incorporating experimental observations into model calculations. Experimentally, the ambipolar potential well phi is measured and is one of the important parameters that strongly affect the confinement properties. In this study, we make use of P/sub $\mu$/, p/sub o/, and phi in transport modeling to predict the scaling of the density (n) and temperatures (T/sub e/, T/sub i/) with these quantities. The scaling calculations are based on neoclassical theory of transport coefficients and experimental observations. A quadratic potential profile and almost flat n and T/sub e/ profiles are assumed. However, to satisfy the ambipolarity condition, the ion temperature profile is retained. Experimentally (EBT-I/S), the electrons are observed to be in the collisionless regime ($\nu/\Omega$/sub o/ $<$ 0.5) and the electron transport coefficients of Spong (similar to those of Kovrizhnykh) are used.

35688 (CONF-810511—, pp 267-276) **Power requirements for ion tail formation in EBT.** Tolliver, J.S.; Jaeger, E.F.; Hedrick, C.L. (Oak Ridge National Lab., TN). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

Experimental evidence suggests the possible presence of an enhanced high energy tail on the ion distribution function, and a simple theoretical analysis indicates that an ion tail may be a major contributor to neoclassical losses which in turn influence the ambipolar potential. In order to study these effects, a kinetic model for neoclassical transport is developed using a Fokker-Planck collision operator and assuming isotropic electron and ion velocity distributions. Three coupled nonlinear integrodifferential equations are solved numerically. The solution shows a non-Maxwellian lowest order ion distribution function. This non-Maxwellian solution leads to higher core ion temperatures and larger ion diffusion rates than those obtained when a Maxwellian distribution is assumed. If the ion tail is further enhanced by a small amount of ad hoc heating, even higher core temperatures and loss rates are obtained.

**35689** (CONF-810511—, pp 277-292) **Effects of fluctuating electric fields on hydrogen and impurity ions in EBT.** Owen, L.W. (Oak Ridge National Lab., TN). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

The effects of fluctuating poloidal electric fields on the orbits and on the heating and loss rates of ions and impurities in EBT are examined. The equations of motion for particles confined to a sector midplane are numerically integrated to yield the temporal behavior of the velocity and position coordinates in the presence of the vacuum magnetic field, a realistic steady state ambipolar electric field, and the sinusoidally varying electric field of a wave propagating in the poloidal direction. It is shown that a wave of modest amplitude, and frequency comparable to typical fluctuation frequencies (10 to 150 KHz) measured in EBT, can lead to large excursions in the kinetic energy and radial position of the hydrogen or impurity ion. The possible relevance of the results of these calculations to the behavior of impurity ions as functions of the mass, charge state, fluctuation level, steady state potential, etc., is discussed.

**35690** (CONF-810511—, pp 293-310) **Anomalous transport and the ambipolar field in EBT.** Krall, N.A.; Klein, H.H. (JAYCOR, San Diego, CA). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

Recent results from the EBT-S experiment suggest that although the confinement times in the device are comparable to neoclassical predictions, the detailed relation between T/sub e/, T/sub i/, and the ambipolar potential phi/sub A/ may be anomalous. This motivates us to resume our earlier work on the modeling of EBT with instability-induced losses. The following work is very much in the nature of a survey to establish the consequences of assumed loss mechanisms. The results are not intended to explain the EBT-S, but to guide future work.

**35691** (CONF-810511—, pp 313) **Radial electric field and potential control in an Electric Field Bumpy Torus (EFBT) plasma.** Roth, J.R. (Univ. of Tennessee, Knoxville). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

**35692** (CONF-810511—, pp 317-328) **Effect of transiting electrons on the ambipolar potential in a Tandem Mirror plasma.** Galbraith, D.L.; Kammash, T. (Univ. of Michigan, Ann Arbor). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

In a standard Tandem Mirror device the electrons trapped in the plugs generally have a temperature which is distinct from that of the central cell electrons. The latter, however, are not restrained by the electrostatic forces from entering the plug region. These electrons which enter the plug are accelerated by the potential across this region to the end of the device where the potential drops below its value in the central cell. At that point most central cell electrons are reflected back across the plug into the central cell once more. These passing electrons exchange energy with the plug electrons while transiting, and for reactor grade plasmas the energy transferred to the plug electrons by these particles can be as large as 60% of the energy flow from the plugs to the central cell. This can result in widening the electron temperature difference between the plug and the central cell which in turn may affect the confining potential.

**35693** (CONF-810511—, pp 341-359) **Instabilities in a small axisymmetric mirror.** Wickham, M. (Univ. of California, Irvine). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

We have observed both the interchange instability and a microinstability which is consistent with the drift cone mode. We have observed these instabilities in an ICRH barium plasma in which T/sub i/ was 3.5 eV and T/sub e/ was .25 eV. The ICRH heating process was studied with the aid of laser-induced fluorescence techniques, by measuring the ion velocity distribution in detail as a function of time that the ICRH was on and as a function of the mirror ratio. There is evidence that the heating process exhibits a very coherent coupling between the RF field and the ion motion.

**35694** (CONF-810511—, pp 363) **Electrostatic potential measurements in the UCLA Large Axisymmetric Mirror Experiment.** Leikind, B.J.; Ferron, J.R.; Young, P.E.; Wong, A.Y. (Univ. of California, Los Angeles). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

**35695** (CONF-810511—, pp 407-422) **Ambipolar potential control by fast wave heating in bumpy tori.** Campbell, R.B. (TRW, Inc., Redondo Beach, CA); Kashuba, R.J.; Kammash, T. Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

The ambipolarity condition in a bumpy torus heated by fast waves is modified because of the neoclassical ion flux produced by wave-particle scatterings. The condition is applied to a case in which the bulk ion species is heated by the fast wave at $\omega = 2\Omega$/sub ci/. We find that the radial profile of ambipolar potential may be modified by introducing the effects of the wave energy deposition profile. Results will be presented to support this claim.

**35696** (CONF-810511—, pp 423-439) **Effect on ambipolar potential of ion cyclotron heating.** Shoji, T.; Tsuboi, F. (Nagoya Univ., Japan). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

Variation of ambipolar potential accompanied with ion cyclotron heating has been studied. The ion cyclotron heating has been carried out in Nagoya Bumpy Torus by using a half turn antenna which is installed near the mirror throat. The frequency of the RF oscillator is chosen to excite a slow wave mode to heat ions. In typical T-mode operation, an increase in ambipolar potential and forming a positive potential hill is observed by using heavy ion beam probe and Langmuir probe. Change in potential is found to be affected by error field and has its maximum value when the field correction current is adjusted so as to minimize the toroidal current.

**35697** (CONF-810511—, pp 441-446) **Initial ICRH experiments on EBT-S.** Baity, F.W. (Oak Ridge National Lab., TN); Eldridge, O.C.; Owens, T.L.; Mullen, J.H.; Henderson, A.L. Sep 1981.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

Steady-state, fast-wave ICRH experiments have been performed at power levels up to 10 kW on EBT-S using an all-metal, double Faraday-shielded 120° loop antenna located in a cavity midplane. A broadband matching circuit was used covering the frequency range of 10 to 50 MHz. The experiments have shown: fairly high antenna loading for majority deuterium, minority hydrogen plasmas; somewhat weaker coupling for pure hydrogen plasmas; strongly damped but apparently propagating waves around the torus; and production of substantial energetic ion tails (from charge-exchange measurements).

**35698 (CONF-810906—10) High-beta studies with beam-heated, non-circular plasmas in ISX-B.** Lazarus, E.A.; Bates, S.C.; Bush, C.E. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01. Order Number DE81032003.

From 10. European conference on controlled fusion and plasma physics; Moscow, USSR (14 Sep 1981).

In this paper we describe some preliminary results of high beta studies on ISX-B for mildly D shaped discharges. ISX-B is a modest size tokamak ($R_0$ = 93 cm, a = 27 cm) equipped with two tangantially-aligned neutral beam injectors giving a total power up to 3 MW. The poloidal coil system allows choice of plasma boundary shapes from circular to elongated ($\kappa \leqq 1.8$), with D, elliptical, or inverse D cross sections. The non-circular work discussed here is for $\kappa \simeq 1.5$.

**35699 (CONF-810961—1) Neutral-beam-heating applications and development.** Menon, M.M. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 81p. NTIS, PC A05/MF A01. Order Number DE82000138.

From Institute of Electrical and Electronics Engineers conference; Atlanta, GA, USA (Sep 1981).

The technique of heating the plasma in magnetically confined fusion devices by the injection of intense beams of neutral atoms is described. The basic principles governing the physics of neutral beam heating and considerations involved in determining the injection energy, power, and pulse length required for a fusion reactor are discussed. The pertinent experimental results from various fusion devices are surveyed to illustrate the efficacy of this technique. The second part of the paper is devoted to the technology of producing the neutral beams. A state-of-the-art account o the development of neutral injectors is presented, and the prospects for utilizing neutral injection to heat the plasma in a fusion reactor are examined.

**35700 (DOE/ET/53016—74) Dark-ground illumination: a quantitative diagnostic for plasma density.** Paul, S.F. (Columbia Univ., New York (USA). School of Engineering and Applied Science). 1981. Contract AS02-76ET-53016. 175p. NTIS, PC A08/MF A01. Order Number DE82000442.

Radial electron density profiles of a toroidal belt pinch plasma have been obtained by a single measurement. Collimated ruby laser light, incident on the plasma, is focused to a diffraction limited spot (100 $\mu$m). The technique, a variation of the dark-ground microscope, involves masking the center of the plasma diffraction pattern with a thin wire. Undiffracted light is blocked by a thin wire, whereas light diffracted by the plasma passes around the wire and onto a photoplate. The resulting interference generates a high contrast fringe pattern whose intensity varies as 1-cos$\Delta$ phi, where $\Delta$ phi is the phase shift induced by the plasma. The fringes are recorded on Polaroid type 46L transparency film. Using this technique, radial density profiles of the plasma produced in the Columbia Torus I belt pinch have been measured. The plasma minor cross section is elliptical with a $\sim$ 2 cm, b $\sim$ 30 cm and $\langle n(0) \rangle \sim 3 \times 10^{16}/cm^3$. Average densities as low as $2 \times 10^{15}/cm^3$ have been measured.

**35701 (DOE/ET/53051—26) High-mode-number MHD stability of a toroidal multipole.** Phillips, M.W. (Wisconsin Univ., Madison (USA)). Sep 1981. Contract AS02-76ET53051. 25p. NTIS, PC A02/MF A01. Order Number DE81030484.

The stability of an axisymmetric plasma with no toroidal magnetic field is studied using a high toroidal mode number expansion of the MHD energy principle. A partial differential eigenvalue equation governing electromagnetic modes is derived. This equation is solved using a perturbation expansion with the inverse toroidal mode number as the smallness parameter resulting in two ordinary differential equations one determining the structure of the mode parallel to magnetic field lines and the other determining structure perpendicular to field lines. The equations are solved numerically for the Levitated Octupole and stability criteria are given.

**35702 (EPRI-ER—215) Fusion-reactor-physics studies in the dc Octopole.** Prater, R.; LaHaye, R.; Wong, S.; Ejima, S.; Moeller, C.; Petersen, P. (General Atomic Co., San Diego, CA (USA)). Aug 1976. 109p. NTIS, PC A06/MF A01. Order Number DE82900116.

Basic physics studies are outlined for each of the following areas: (1) de octupole, (2) plasma sources and diagnostics, (3) confinement of a plasma in the trapped electron mode, (4) trapped electron mode study, (5) rf plasma heating, and (6) trapped ion mode regime study. (MOW)

**35703 (EPRI-ER—268) Study of fast magnetosonic-wave and neutral-beam heating of large tokamaks. Topical report.** Conn, R.W.; Kulcinski, G.L. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Sep 1976. 70p. NTIS, PC A04/MF A01. Order Number DE82900006.

Studies are presented of wave and neutral beam heating of tokamak plasma. The leading wave heating candidates include low frequency Alfven waves, fast magnetosonic waves, lower hybrid waves, and electron cyclotron waves and these are briefly surveyed. A more detailed consideration is given to the fast magnetosonic wave and its use in heating a tokamak reactor to ignition. A conceptual magnetosonic wave launching system compatible with reactor plasmas is also described. The status of neutral beam heating, the requirements on injection energies, and the resulting heating profiles for reactor plasmas are described. Finally a comparison of RF (radiofrequency) and neutral beam heating is presented. Neutral beams enjoy a very good agreement between present theory and experiment. However, potential penetration and heating of the plasma core and the required source development for reactors favor RF heating. The advantages and problems associated with extrapolating both techniques to reactor plasmas are described. It is concluded that a high priority should be given to definitive high power RF tokamak heating experiments to clarify the physics base. A large effort on high energy neutral beam source development as is currently underway is also required.

**35704 (GA-A—16460) Neutral density measurements in Doublet III.** deGrassie, J.S.; DeBoo, J.C.; Mahdavi, M.A.; Ohyabu, N.; Shimada, M. (General Atomic Co., San Diego, CA (USA); Japan Atomic Energy Research Inst., Tokyo). Aug 1981. Contract AT03-80SF11512;AT03-76ET51011. 16p. (CONF-811113—14). NTIS, PC A02/MF A01. Order Number DE82000497.

From American Vacuum Society national symposium; Anaheim, CA, USA (3 Nov 1981).

In the Doublet III tokamak a variety of cross-sectionally shaped plasmas has been investigated. Simple magnetically shielded ionization gauges monitoring the working gas pressure show a striking dependence upon plasma shape. Average neutral density varies over two orders of magnitude. In the extreme cases of the simplified poloidal divertor shapes the pressure exceeds $10^{-3}$ torr.

**35705 (ORNL/TM—8021) Review of recent EBT coupled ring-core stability theory.** Spong, D.A. (Oak Ridge National Lab., TN (USA)). Oct 1981. Contract W-7405-ENG-26. 32p. NTIS, PC A03/MF A01. Order Number DE82000880.

During the past several years Elmo Bumpy Torus (EBT) stability calculations have evolved with respect to treatment of ring-core plasma coupling effects. This evolution began with recognition of the important role of ring compressibility and paramagnetic effects on core beta limits. Since then, models have continued to increase in sophistication, including ring-core frequency coupling, velocity space and hot electron distribution function effects, and radially dependent models. Some of these features have resulted in wide variations in predicted plasma performance limitations. A number of the models will be reviewed and assumptions to which they are particularly sensitive will be discussed.

**35706 (UCID—19175) Results of the LLNL plasma focus project.** Wainwright, T.; Pickles, W.; McClure, J.; Price, D.; Eltgroth, P. (Lawrence Livermore National Lab., CA (USA)). Aug 1981. Contract W-7405-ENG-48. 52p. NTIS, PC A04/MF A01. Order Number DE81030690.

The following chapters are included: (1) detailed description of PF operation prior to pinch, (2) PF experiments with DT-filled

microballoons, (3) diagnosis of electron beam produced by PF (x rays), and (4) PF experiments with solid objects at pinch location. (MOW)

**35707 (UCRL—85579) Numerical simulation of the Beta II experiment.** Shumaker, D.E.; Boyd, J.K.; McNamara, B.; Turner, W.C. (Lawrence Livermore National Lab., CA (USA)). Oct 1981. Contract W-7405-ENG-48. 16p. (CONF-811028—1). NTIS, PC A02/MF A01. Order Number DE81030884.

From 23. annual meeting of the division of plasma physics of the APS; New York, NY, USA (12 Oct 1981).

The transport code FRT which is a 1-1/2-D transport-equilibrium code for an axisymmetric plasma was used to simulate the decay of the plasma and magnetic fields of the Beta II experiment. A comparison is made between the experimentally determined decay times for the magnetic fields and particle confinement times and the computed decay times. It is found that 1% oxygen impurity is enough to clamp the electron temperature below the radiation barrier, which is in agreement with the experiment.

**35708 Characteristics of ablation plasma from planar, laser-driven targets.** Grun, J.; Decoste, R.; Ripin, B.H.; Gardner, J. (Naval Research Laboratory, Washington D.C. 20375). *Applied Physics Letters ;* **39**: No. 7, 545-547(1 Oct 1981).

The momentum, energy, and velocity characteristics of plasma ablating from planar targets irradiated by long Nd-laser pulses (4 ns, $< 10^{14}$ W/cm$^2$) are measured and the dependence of ablation parameters upon absorbed irradiance is determined. Large laser spots are used in these experiments so that the results are not sensitive to boundary effects.

**35709 2nd—5th electron cyclotron harmonic emission from thermal plasmas in Alcator A.** Woskoboinikow, P.; Praddaude, H.C.; Falconer, I.S.; Mulligan, W.J. (Plasma fusion center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Applied Physics Letters ;* **39**: No. 7, 548-550(1 Oct 1981).

A sensitive submillimeter heterodyne receiver has been used to measure electron cyclotron emission at the 2nd through the 5th harmonics from thermal plasmas in Alcator A. A sensitive diagnostic of the electron energy distribution function is obtained from intensity ratios of the optically thin harmonics, in particular the small runaway fraction ($\sim 10^{-6}$) that exists even in well thermalized Alcator A plasmas. Also the 4th and 5th harmonics are a sensitive measure of impending plasma disruption due to vessel air leaks.

**35710 Comparison of two equation-of-state models for partially ionized aluminum: Zel'dovich and Raizer's model versus the activity expansion code.** Harrach, R.J.; Rogers, F.J. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Applied Physics ;* **52**: No. 9, 5592-5596(Sep 1981).

Two equation-of-state (EOS) models for multipy ionized matter are evaluated for the case of an aluminum plasma in the temperature range from about one eV to several hundred eV, spanning conditions of weak to strong ionization. Specifically, the simple analytical mode of Zel'dovich and Raizer and the more comprehensive model comprised by Rogers' plasma physics avtivity expansion code (ACTEX) are used to calculate the specific internal energy $\epsilon$ and average degree of ionization Z-bar*, as functons of temperature T and density rho. In the absence of experimental data, these results are compared against each other, covering almost five orders-of-magnitude variation in $\epsilon$ and the full range of Z-bar* We find generally good agreement between the two sets of results, especially for low densities and for temperatures near the upper end of the rage. Calculated values of $\epsilon$(T) agree to within +- 30% over nearly the full range in T for densities below about 1 g/cm$^3$. Similarly, the two models predict values of Z-bar*(T) which track each other fairly well; above 20 eV the discrepancy is less than +- 20% fpr rho< or $\simeq$1 g/cm$^3$. Where the calculations disagree, we expect the ACTEX code to be more accurate than Zel'dovich and Raizer's model, by virtue of its more detailed physics content.

**35711 Physical mechanism of wave-particle resonances in an inhomogeneous magnetic field. I. Linear theory.** Huba, J.D.; Drake, J.F. (Science Applications, Inc., McLean, Virginia 22102). *Physics of Fluids ;* **24**: No. 9, 1650-1654(Sep 1981).

A physical description is given of the wave-particle resonance which can occur when particles undergoing a del B drift are in phase with a wave propagating across the magnetic field (i.e., $\omega \sim$ kxV/sub deltsB/, where V/sub deltsB/ is the del B drift velocity). Specifically, the physics of the energy exchange mechanism is discussed and a general equation for the wave damping/growth rate is derived based upon physical arguments. The theory is applied to the lower-hybrid-drift instability and collisionless trapped electron instability.

**35712 Tilting instability of a cylindrical spheromak.** Bondeson, A.; Marklin, G.; An, Z.G.; Chen, H.H.; Lee, Y.C.; Liu, C.S. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Physics of Fluids ;* **24**: No. 9, 1682-1688(Sep 1981).

The stability of a low-beta spheromak with a perfectly conducting cylindrical boundary of length L and radius R is analyzed in terms of force-free fields with J = $\lambda$B($\lambda$ = const). The axisymmetric equilibrium is found unstable to tilting when the elongation L/R is larger than about 1.67. Numerical solutions of the time-dependent ideal magnetohydrodynamic equations confirm this result.

**35713 Atmospheric type modes in laser fusion targets.** Scannapieco, A.J. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids ;* **24**: No. 9, 1699-1705(Sep 1981).

The fluid stability of laser-fusion targets is considered as a stability problem of a pseudo-planetary atmosphere. Three atmospheric type modes are studied; acoustic, gravity, and Lamb modes. The changing character (i.e., growing, oscillatory, or growing-oscillatory) of each is investigated as a function of the density-gradient scale length H of the fluid. A growing class of modes is found which is distinct from the gravity (i.e., Taylor) mode if a gradient in entropy exists in the fluid. These modes are shown to be overstable Lamb modes. Also, the gravity mode is only stable for a distinct band of values of H. These values, at which the density and Lamb modes change character, are derived from the dispersion relation for the modes. Finally, the consequences for laser targets are discussed.

**35714 Microwave heating of the ELMO Bumpy Torus relativistic electron ring.** Hamasaki, S.; Klein, H.H.; Krall, N.A.; McBride, J.B.; Sperling, J.L. (JAYCOR, San Diego, California 92138). *Physics of Fluids ;* **24**: No. 9, 1706-1715(Sep 1981).

A model for microwave heating of electron rings in the ELMO Bumpy Torus configuration is analyzed using a relativistically correct quasi-linear formulation. The spatial locations of heating by the different electron-cyclotron harmonics are calculated. The steady-state ring energy and the microwave power required to sustain the rings are determined by balancing the line-averaged heating rate against classical collisional and radiative energy loss processes. Although ring formation is generally attributed to the second harmonic electron-cyclotron resonance, the calculations show that fundamental heating also plays a critical role in ring start-up and steady state. The model predicts ring power requirements for EBT which are consistent with previous estimates.

**35715 Hamiltonian formulation of guiding center motion.** Littlejohn, R.G. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physics of Fluids ;* **24**: No. 9, 1730-1749(Sep 1981).

A Hamiltonian theory of guiding center motion which uses rectangular coordinates in physical space and noncanonical coordinates in phase space is presented. The averaging methods preserve two important features of Hamiltonian systems, viz., conservation of energy (for time-independent fields) and Liouville's theorem. These features are sacrificed by the traditional averaging methods. The methods also relieve much of the burden of higher order perturbation calculations, and the drift equations for fully electromagnetic fields are extended to one higher order than they have been

known in the past. The first correction to the relativistic magnetic moment is also calculated. Many applications are anticipated, both to single particle motion and to kinetic theory.

35716 **Analytic field-reversed equilibria.** Berk, H.L.; Hammer, J.H.; Weitzner, H. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physics of Fluids ;* **24**: No. 9, 1758-1759(Sep 1981).

Several families of analytic equilibria for field-reversed plasma are obtained for arbitrary internal pressure and toroidal field.

35717 **m-spectrum analyzer on Alcator-C.** Granetz, R.S. (Massachusetts Institute of Technology, Department of Physics and Plasma Fusion Center, M.I.T., Room NW16—273, 167 Albany Street, Cambridge, Massachusetts 02139). *Review of Scientific Instruments ;* **52**: No. 9, 1332-1337(Sep 1981).

An experiment currently being developed on the Alcator-C magnetic fusion device uses a set of poloidal B-field pick-up coils and unique analyzing circuits to continuously yield the amplitudes, frequencies, and rotational directions of the m = 1,2,3,4, and 5 resistive MHD tearing modes. The experiment is being used to study the growth and coupling of tearing modes of different helicities due to density, temperature, and current profiles.

35718 **Mass spectrometric evidence for suprathermal ionization in an inductively coupled argon plasma.** Houk, R.S.; Svec, H.J.; Fassel, V.A. (Ames Laboratory-USDOE and Department of Chemistry, Iowa State University, Ames, Iowa 50011). W-7405-ENG-82. *Applied Spectroscopy ;* **35**: No. 4, 380-384(Jul 1981).

Mass spectra have been obtained of species in the axial channel of an inductively coupled argon plasma by extracting ions from the inductively coupled plasma into a vacuum system housing a quadrupole mass spectrometer. Ionization temperatures (T/sub ion/ ) are obtained from relative count rates of m/z-resolved ions according to two general types of ionization equilibrium considerations: (a) the radio of doubly/singly charged ions of the same element, and (b) the ratio of singly charged ions from two elements of different ionization energy. The T/sub ion/ values derived from measurement of $Ar^{+2}/Ar^{+}$, $Ba^{+2}/Ba^{+}$, $Sr^{+2}/Sr^{+}$, and $Cd^{+}/I^{+}$ are all greater than those expected from excitation temperatures measured by other workers. The latter three values for T/sub ion/ are in reasonable agreement with values obtained by optical spectrometry for a variety of argon inductively coupled plasmas.

35719 **Implicit moment particle simulation of plasmas.** Mason, R.J. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Journal of Computational Physics ;* **41**: No. 1, 233-244(Jun 1981).

It is shown that an implicit E field can be obtained from Poisson's equation with the aid of the lower two fluid moment equations, permitting stable particle simulations for ω/sub p/ $\Delta t >> 1$ and $\Delta x/\lambda$/sub D/ >> 1, where ω/sub p/ and λ/sub D/ are the plasma frequency and Debye length, respectively. In the quasi-neutral limit the effect of this E is to provide just the predicted current required to drive all present deviations in the total charge density to zero in the next cycle. In near vacuum, or with ω/sub p/ $\Delta t >> 1$, the field expression reduces to the standard form used with conventional leapfrog schemes. Sample applications are discussed.

## 7002 Fusion Power Plant Technology

*REFER ALSO TO CITATION(S) 34514, 34927, 35186, 35189, 35190, 35191, 35208, 35363, 35389, 35713*

35720 **(BNL—29826) Review of melting and evaporation of fusion-reactor first walls.** Fillo, J.A.; Makowitz, H. (Associated Universities, Inc., Washington, DC (USA); Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 8p. (CONF-811101—10). NTIS, PC A02/MF A01. Order Number DE81030035.

From Winter annual meeting of the ASME Technology and Society Division; Washington, DC, USA (15 Nov 1981).

The most severe thermal loading on the first wall will occur when the plasma becomes unstable resulting in a hard plasma disruption or at the end of a discharge when the plasma is dumped on the wall in a very short period of time. Hard plasma disruptions are of particular concern in future fusion reactors where the thermal energy of the plasma may reach values on the order of 300 MJ. Sufficiently high heating rates can occur to melt the first wall surface, and the temperature can increase resulting in vaporization. Thermal models are reviewed which treat these problems.

35721 **(BNL—30002) Fusion plasma control using TRAIL: a nondamageable limiter.** Yu, W.S.; Powell, J.R.; Fillo, J.A.; Usher, J.L. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 6p. (CONF-811103—41). NTIS, PC A02/MF A01. Order Number DE81030825.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

An attractive new limiter system is described, termed TRAIL (Tokamak Rail Gun Limiter), which can inject streams of pellets into the plasma to: (a) define the plasma boundary, (b) absorb plasma disruption energy, and (c) control plasma temperature profiles. Using EM (Electromagnetic) guns now being developed for military applications, particles can be injected at velocities in the range of meters to several kilometers per second. Transient heat transfer analyses are presented for various pellet sizes (0.5 to 1.5 cm diam), heat fluxes (5000 to 200,000 W/cm$^2$), compositions (Al, Cu, C, Mo, and Li) and heat pulse length (2.5 to 50 ms).

35722 (CONF-801011—(Vol.1), pp 47-51) **Fusion effort in China.** Li, X. (Southwestern Inst. of Physics, Sichuan, China). Jul 1981. NTIS, PC A13/MF A01. Order Number DE81027359.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

35723 (CONF-801011—(Vol.3), pp 926-931) **Advanced fuel fusion fuels and reactor concepts.** Gordon, J.D. (TRW Defense and Space Systems Group, Redondo Beach, CA). Jul 1981. NTIS, PC A99/MF A01. Order Number DE81027361.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

35724 (CONF-801011—(Vol.3), pp 932-940) **Confinement approaches for burning alternate fuels.** Miley, G.H.; Blue, T.; Choi, C.; Gilligan, J.; Greenspan, E. (Univ. of Illinois, Urbana). Jul 1981. NTIS, PC A99/MF A01. Order Number DE81027361.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

35725 (CONF-810511—, pp 205-232) **Field errors in EBT and their effects on the ambipolar potential.** Uckan, T.; Bieniosek, F.M.; Solensten, L. (Oak Ridge National Lab., TN). Sep 1981. NTIS, PC A20/MF A01. Order Number DE81030636.

From Workshop on ambipolar potential formation and control in bumpy tori and mirrors; Oak Ridge, TN, USA (11 May 1981).

Because the ELMO Bumpy Torus (EBT) is a closed field line device, it is very sensitive to small magnetic field asymmetries - field errors ($\Delta B/B \leqq 1.5 \times 10^{-4}$). Such field errors are unavoidable due to minute coil misalignments (0.25 mm) and the ubiquitous earth's field ($B \sim 5 \times 10^{-5}$ T). If the inherent error field of the device is large enough, it causes: (1) a distortion of the poloidal symmetry of the potential profile and even a total disappearance of the ambipolar potential well, leading in turn to a deterioration of the plasma confinement parameters; (2) the establishment of a toroidal current and, therefore, enhancement of fluctuations; and (3) an opening of the confined closed drift surfaces that increases particle diffusion.

35726 **(CONF-8009179—1) Status of ORR spectral tailoring and HFIR irradiation experiments.** Grossbeck. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01. Order Number DE81032008.

From ADIP program review meeting; Germantown, MD, USA (30 Sep 1980).

Diagrams are given showing He vs dpa levels expected on the first wall of a fusion reactor and expectations from various fission reactors. Data on the ORR and HFIR spectral tailoring experiments are given. (MOW)

35727 **(CONF-8009179—3) Swelling and microstructure of HFIR irradiated austenitic stainless steels.** Maziasz, P.J. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01. Order Number DE82000158.

From ADIP program review meeting; Germantown, MD, USA (30 Sep 1980).

The swelling and microstructural information available from HFIR-CTRs-9-13 are summarized and compared for CW 316 and CW(316 + Ti). These experiments were irradiated to moderate fluences of about 8 to 16 dpa and 500 to 1000 at. ppM He at irradiation temperatures ranging from 285 to 670°C. These results are compared to higher fluence HFIR irradiation of CW 316 from HFIR-CTRs-2-8 irradiated at 375 to 680°C at fluences up to 61 dpa and 4200 at. ppM He. Both the high- and low-fluence cavity volume fraction swelling curves for CW 316 have a similar shape. The curves show a definite swelling minimum at 470 to 570°C that corresponds to the temperature of maximum precipitation. The swelling increases rather sharply with temperature at the higher and lower temperatures. The moderate fluence swelling levels are all below 0.5% $\Delta V/V_0$.

35728 **(CONF-8009179—4) Tensile properties and microstructure of helium-injected and reactor-irradiated V-20 Ti.** Tanaka, M.P.; Bloom, E.E.; Horak, J.A. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01. Order Number DE81032005.

From ADIP program review meeting; Germantown, MD, USA (30 Sep 1980).

The ojective of this work was to determine the effect of preinjected helium followed by neutron irradiation on the mechanical properties and microstructure of V-20% Ti. (MOW)

35729 **(CONF-8009179—5) Resistance of $(Fe,Ni)_3V$ long-range-ordered alloys to radiation damage.** Braski, D.N. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 18p. NTIS, PC A02/MF A01. Order Number DE81032006.

From ADIP program review meeting; Germantown, MD, USA (30 Sep 1980).

The $(Fe,Ni)_3V$ long-range-ordered (LRO) alloys (path D) are being developed at ORNL for possible application as a first-wall material for a fusion reactor. Alloys with different Fe/Ni ratios have been screened for their resistance to radiation by irradiating them with 4 MeV Ni ions to 70 dpa at temperatures from 525 to 680°C. Helium (8 at. ppM/dpa) and deuterium ions (28 at. ppM/dpa) were simultaneously injected to better simulate fusion reactor conditions. Alloy LRO-16 (31 wt % Ni) contained sigma phase and showed swelling behavior similar to the 20%-cold-worked 316 stainless steel that was used as an internal standard. LRO-20 (39.5 wt % Ni), without sigma phase, swelled slightly less than the 316 stainless steel. Both alloys demonstrated noticeably lower swelling behavior when their composition was changed to include 0.4 wt % ti.

35730 **(CONF-8009179—6) Influence of irradiation on the tensile properties of austenitic stainless steel weldments.** Wiffen, F.W.; Edmonds, D.P.; Horak, J.A.; King, J.F. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01. Order Number DE81032002.

From ADIP program review meeting; Germantown, MD, USA (30 Sep 1980).

Weldments in the first wall and front sections of the blanket of a fusion reactor will be exposed to approximately the same operating conditions as will the base metal. Thus the irradiation response of weld metal, of the weld heat affected zones in the base metal, and of the base metal are all of equal concern. Austenitic stainless steels will most likely be joined by a gas tungsten arc welding process. Welds have been made by this process between sections of 6-mm-thick (0.25 in.) base plate of type 316 in the 20%-cold-worked condition, with either type 316 or 16-8-2 stainless steel filler metal. Rod tensile specimens were cut through the welds, containing weld meta in the central gage portion. Weld-contaning tensile specimens have been irradiated in HFIR at 55°C and throughout the temperature range 280 to 620°C. The neutron fluences ranged from 0.5 to 1.6 x $10^{26}$ $n/m^2$ (> 0.1 MeV). The corresponding displacement damage levels range from 4.5 to 12.1 dpa, and the helium generation from the thermal neutron captures in nickel resulted in 100 to 550 at. ppM He.

35731 (DOE/ER/10044—T1, pp 15p, Attachment J) **Conceptual design of the Purdue compact torus/passive liner fusion reactor.** Terry, W.K. 15 Jul 1981. NTIS, PC A15/MF A01. Order Number DE81025882.

In Progress report to the Department of Energy in support of basic energy and policy research.

This proposal describes a program for the conceptual development of a novel fusion reactor design, the Purdue Compact Torus/Passive Liner Reactor. The key features of the concept are described and a comparison is made with a conventional tokamak. (MOW)

35732 **(DOE/ER/52058—T1) Design analysis of supplemental heating systems. Final report.** (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). Sep 1981. Contract AC03-80ER52058. 239p. NTIS, PC A11/MF A01. Order Number DE81030678.

The main emphasis of this study is to formulate R and D program priority for the future development of the heating techniques. A secondary emphasis is to improve the present state of knowledge of reactor heating systems. The technique used to determine R and D program priority was to evaluate each technique against a set of selection criteria. The selection criteria were divided into two categories. The first category contains the criteria that are normally used to evaluate the potential of any idea to proceed into hardware development; the status of the theory; the status of the technology; system efficiency; and cost. The second category contains the criteria that have important implications for reactor level devices: susceptibility to radiation, maintainability; and critical real estate requirements.

35733 **(DOE/ER/52058—T1-Exect.Summ.) Design analysis of supplemental heating systems. Final report.** (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). Sep 1981. Contract AC03-80ER52058. 13p. NTIS, PC A02/MF A01. Order Number DE82030677.

The first objective of the study was to formulate an R and D plan for tokamak supplemental heating based upon an evaluation and the potential of each heating technique. The second objective was to develop conceptual designs for reactor level heating systems. The two techniques selected for the second studies were icrh and negative beams. (MOW)

35734 **(DOE/ET/51013—23) Cycle design for a cryogenic refrigeration system for FED with Forced-Flow Superfluid Helium through internally cooled conductors.** Schultz, J.H. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). 1981. Contract AC02-78ET51013. 19p. (PFC/RR—81-29). NTIS, PC A02/MF A01. Order Number DE82000446.

A cryogenic refrigeration system has been designed for the specifications of the magnet system of the Fusion Engineering Device (FED). The unusual specification of an internally cooled cabled niobium titanium superconductor at a maximum field of 10 tesla, coupled with high ac losses and high neutron and gamma heating in the toroidal field coils led to the selection of a cooling system with superfluid helium at the inlet to the toroidal field coils. While highly unusual as a coil-cooling concept, the implications for the refrigeration system were not unfavorable and showed several features of interest. Among the favorable comparisons with conven-

tional supercritical flow systems were reduced entropy generation in the coil due to pressure drops. However, the low inlet temperature and the high losses combined to require 63 MW of room temperature work on the helium, about 4 times that of the Isabelle refrigeration system, which the FED system resembles.

**35735 (EPRI-ER—203) Assessment of laser-driven fusion. Final report.** (Brueckner (K.A.) and Associates, Inc., La Jolla, CA (USA)). Sep 1976. 166p. NTIS, PC A08/MF A01. Order Number DE82900026.

This final report on Assessment of Laser Fusion contains details of the national fusion program as of March 1976. It includes a general summary by the Laser Fusion Advisory Committee as well as a summary by the Working Group. The detailed scientific and technical evaluations of the national laser fusion program are presented in four parts, an overall assessment, engineering feasibility, scientific feasibility, and site visits.

**35736 (EPRI-ER—216) Applications of low-atomic-number ceramic materials to fusion-reactor first walls. Final report.** Rovner, L.H.; Bourque, R.F.; Chen, K.Y. (General Atomic Co., San Diego, CA (USA)). Aug 1976. 129p. NTIS, PC A07/MF A01. Order Number DE82900117.

Conceptual designs are presented for radiating and convectively-cooled first wall panels using near-isotropic graphite and hot-pressed and self-bonded silicon carbide. Other designs are shown for direct-contact liners, a rotating limiter with in-situ replenishment of the erosion surface, and a self-adjusting support mechanism to ensure uniform charged particle heating of the individual wall panels. The designs allow for surface erosion, stresses due to temperature differentials, transients, nuclear heating, and neutron-induced differential swelling and creep.

**35737 (EPRI-SR—24) Exploratory discussions concerning a possible EPRI/Kurchatov Institute joint program on fusion power.** Scott, F.R. (ed.). (Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1975. 48p. NTIS, PC A03/MF A01. Order Number DE82900103.

A trip report describing the meetings and giving the EPRI delegation's summary, evaluation, and recommendations is given. (MOW)

**35738 (GA-A—16445) Expanded boundary divertor experiments in Doublet III.** Wesley, J.C.; Brooks, N.H.; DeBoo, J.C.; deGrassie, J.S.; Groebner, R.J.; Hsieh, C.L.; Mahdavi, M.A.; Ohyabu, N.; Stambaugh, R.D.; Taylor, T. (General Atomic Co., San Diego, CA (USA)). Jul 1981. Contract AT03-76ET51011. 24p. (CONF-810745—2). NTIS, PC A02/MF A01. Order Number DE81030399.

From IAEA technical committee meeting on divertors and impurity control in tokamaks; Garching, F.R. Germany (6 Jul 1981).

The expanded boundary divertor configuration establishes a divertor plasma characterized by high density and low temperature and produces hydrogen pressures below the divertor region up to $10^{-3}$ Torr. The divertor density was found to rise nonlinearly with the main plasma density anti n/sub e/, scaling approximately as anti n/sub e/$^{3}$. This behavior can be described by a simple one-dimensional parallel heat flow model that neglects radiation and particle transport except near the target plate (wall). The model further predicts that the divertor temperature scales as anti n/sub e/$^{-2}$.

**35739 (HEDL-SA—2355-FP) Fusion-reactor blanket and coolant material compatibility.** Jeppson, D.W.; Keough, R.F. (Hanford Engineering Development Lab., Richland, WA (USA)). 1981. Contract AC14-76FF02170. 7p. (CONF-810831—56). NTIS, PC A02/MF A01. Order Number DE81030018.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

Fusion reactor blanket and coolant compatibility tests are being conducted to aid in the selection and design of safe blanket and coolant systems for future fusion reactors. Results of scoping compatibility tests to date are reported for blanket material and water interactions at near operating temperatures. These tests indicate the quantitative hydrogen release, the maximum temperature and pressures produced and the rates of interactions for selected blanket materials.

**35740 (HEDL-SA—2508) FMIT test cell diagnostics: a unique materials challenge.** Cannon, C.P.; Fuller, J.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1981. Contract AC14-76FF02170. 6p. (CONF-810831—40). NTIS, PC A02/MF A01. Order Number DE81029762.

From Fusion reactor materials meeting; Seattle, WA, USA (9 Aug 1981).

Basic materials problems are discussed in instrumenting the FMIT test cell, which are applicable to fusion devices in general. Recent data on ceramic-to-metal seals, mineral insulated instrument cables, thermocouples, and optical components are reviewed. The data makes it clear that it would be a mistake to assume that materials and instruments will behave in the FMIT test cell environment as they do in more familiar fission reactors and low power accelerators.

**35741 (NRL-MR—4626) Rayleigh-Taylor and Kelvin-Helmholtz instabilities in targets accelerated by laser ablation.** Emery, M.H.; Gardner, J.H.; Boris, J.P. (Naval Research Lab., Washington, DC (USA)). 25 Sep 1981. Contract AI01-76ET53020. 19p. NTIS, PC A02/MF A01. Order Number DE82000237.

Using the FAST2D laser-shell simulation model we have accelerated a 20 $\mu$m thick plastic foil up to 160 km/s. The foil maintained its integrity up to 10 ns giving an aspect ratio of 40. We are able to follow the Rayleigh-Taylor bubble-and-spike development far into the nonlinear regime and beyond the point of foil fragmentation. Strong shear flow develops at the interface between the bubble-and-spike which leads to the development of the Kelvin-Helmholtz instability. The K-H instability causes the tips of the spikes to widen and as a result reduce their rate of fall.

**35742 (ORAU—184) Manpower requirements and supply for magnetic-fusion energy, 1981-2000.** Finn, M.G.; Hansen, A.H.; Harr, P.A. (Oak Ridge Associated Universities, Inc., TN (USA)). Sep 1981. Contract AC05-76OR00033. 104p. NTIS, PC A06/MF A01. Order Number DE81030064.

This study has been conducted to help the US Department of Energy (DOE) complete a task assigned to it by the Magnetic Fusion Energy Engineering Act of 1980 (P.L. 96-386). The law requires that the Secretary make recommendations regarding the need for increased support for education in engineering and scientific disciplines. This study focuses on estimating current employment and future manpower requirements for magnetic fusion energy to the year 2000. It also examines sources of labor for fusion energy and competing demands for the disciplines most important to the future growth of fusion energy.

**35743 (ORNL/TM—7878) Calculated neutron and gamma-ray energy spectra from 14-MeV neutrons streaming through an iron duct: comparison with experiment.** Santoro, R.T.; Alsmiller, R.G. Jr.; Barnes, J.M.; Chapman, G.T.; Tang, J.S. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 64p. NTIS, PC A04/MF A01. Order Number DE81030626.

Integral experiments that measure the streaming of $\sim$ 14 MeV neutrons through a 0.30-m-diameter iron duct (L/D $\sim$ 3) imbedded in a concrete shield have been carried out at the Oak Ridge National Laboratory. Calculated and measured neutron and gamma-ray energy spectra are compared at sixteen detector locations on and off the cylindrical axis of the duct. The measured spectra were obtained using an NE-213 liquid scintillator detector with pulse-shape discrimination to simultaneously resolve neutron and gamma ray events. The calculated spectra were obtained using a computer code network that incorporates two radiation transport methods: discrete ordinates (with $P_3$ multigroup cross sections) and Monte Carlo (with continuous-point cross sections). The two radiation transport methodologies are required to properly account for neutrons that single scatter from the duct to the detector. The calculated and measured outgoing neutron energy spectra above 850 keV agree within 5 to 50% depending on detector location and neutron energy. The calculated and measured gamma ray spectra

above 750 keV are also in favorable agreement, ~ 5 to 50%, depending on detector location and gamma ray energy.

35744 **(ORNL/TM—7911) Monte Carlo simulation of molecular flow in a neutral-beam injector and comparison with experiment.** Lillie, R.A.; Gabriel, T.A.; Schwenterly, S.W.; Alsmiller, R.G. Jr.; Santoro, R.T. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 30p. NTIS, PC A03/MF A01. Order Number DE82000503.

Monte Carlo calculations have been performed to obtain estimates of the background gas pressure and molecular number density as a function of position in the PDX-prototype neutral beam injector which has undergone testing at the Oak Ridge National Laboratory. Estimates of these quantities together with the transient and steady-state energy deposition and molecular capture rates on the cryopanels of the cryocondensation pumps and the molecular escape rate from the injector were obtained utilizing a detailed geometric model of the neutral beam injector. The molecular flow calculations were performed using an existing Monte Carlo radiation transport code which was modified slightly to monitor the energy of the background gas molecules. The credibility of these calculations is demonstrated by the excellent agreement between the calculated and experimentally measured background gas pressure in front of the beamline calorimeter located in the downstream drift region of the injector. The usefulness of the calculational method as a design tool is illustrated by a comparison of the integrated beamline molecular density over the drift region of the injector for three modes of cryopump operation.

35745 **(ORNL/TM—7912) Field errors in EBT and their effects on the ambipolar potential.** Uckan, T.; Bieniosek, F.M.; Solensten, L. (Oak Ridge National Lab., TN (USA)). Oct 1981. Contract W-7405-ENG-26. 36p. NTIS, PC A03/MF A01. Order Number DE82000828.

Because the ELMO Bumpy Torus (EBT) is a closed field line device, it is very sensitive to small magnetic field asymmetries - field errors ($\Delta B/B \leqq 1.5 \times 10^{-4}$). Such field errors are unavoidable due to minute coil misalignments (0.25 mm) and the ubiquitous earth's field ($B \sim 5 \times 10^{-5}$ T). If the inherent error field of the device is large enough, it causes: (1) a distortion of the poloidal symmetry of the potential profile and even a total disappearance of the ambipolar potential well, leading in turn to a deterioration of the plasma confinement parameters; (2) the establishment of a toroidal current and, therefore, enhancement of fluctuations; and (3) an opening of the confined closed drift surfaces that increases particular diffusion.

35746 **(ORNL/TM—7999) Dose rates from the induced activity in the ETF neutral beam intector.** Santoro, R.T.; Barnes, J.M.; Lillie, R.A.; Alsmiller, R.G. Jr. (Oak Ridge National Lab., TN (USA)). Oct 1981. Contract W-7405-ENG-26. 21p. NTIS, PC A03/MF A01. Order Number DE82000827.

The dose equivalent rates outside the Engineering Test Facility neutral beam injector shield from the induced radioactivity have been calculated for the reactor operating at 1140 MW for 1, 30, and 365 days. The dose rates at one day after shutdown are large even after only one day of operation. Depending on the location and operating time, cooling times from 30 d to ~ 5 years are required before the dose rates are sufficiently low to allow routine maintenance work in the vicinity of the NBI shield.

35747 **(PPPL—1785) Design of the PDX Tokamak wall armor and inner limiter system.** Kugel, H.W.; Ulrickson, M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1981. Contract AC02-76CH03073. 30p. NTIS, PC A03/MF A01. Order Number DE81030885.

The inner wall protective plates for the PDX Tokamak are designed to absorb 8 MW of neutral deuterium beam power at maximum power densities of 3 kW/cm$^2$ for pulse lengths of 0.5 sec. Preliminary studies indicate that the design could survive several pulses of 1 sec duration. The design consists of a tile and mounting plate structure. The mounting plates are water cooled to allow short duty cycles and beam calorimetry. The temperature and flow of the coolant is measured to obtain the injected power. A thermocouple array on the tiles provides beam position and power density profiles. Several material combinations for the tiles were subjected to thermal tests using both electron and neutral beams, and titanium carbide coated graphite was selected as the tile material. The heat transfer coefficient of the tile backing plate structure was measured to determine the maximum pulse rate allowable. The design of the armor system allows the structure to be used as a neutral beam power diagnostic and as an inner plasma limiter. The electrical and cooling systems external to the vacuum vessel are discussed.

35748 **(SAND—81-1508C) Light ion beams as the driver for inertial-confinement fusion.** Bieg, K.W.; Kuswa, G.W. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 23p. (CONF-811113—2). NTIS, PC A02/MF A01. Order Number DE81030116.

From American Vacuum Society national symposium; Anaheim, CA, USA (3 Nov 1981).

This paper presents a brief description of and recent results in the areas of pulse power systems, ion generation and focusing, target irradiation experiments, and light ion driven fusion reactor concepts, and several areas of development in which improved materials are either required, or could greatly influence progress toward fusion is described.

35749 **(SAND—81-2001C) Transient magnetic-field calculations with TRIDIF.** Hodgdon, M.L.; Freeman, J.R. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 10p. (CONF-810954—1). NTIS, PC A02/MF A01. Order Number DE81030843.

From COMPUMAG conference; Argonne, IL, USA (14 Sep 1981).

TRIDIF is a time-dependent diffusion version of the well-known PANDIRA-POISSON-TRIM triangular mesh magnet code. Modifications which allow TRIDIF to treat field diffusion in materials with time-varying permeabilities are described. A heuristic dipole alignment model which describes major and minor hysteresis loops and frequency dependence has been included to provide the requisite permeabilities. Good agreement between the measured and computed magnetic fields was found for a simple test experiment.

35750 **(UCID—18773) X-ray backlighting requirements for the double-shell target.** Larsen, J.T. (Lawrence Livermore National Lab., CA (USA)). 26 Aug 1980. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01. Order Number DE81000241.

We have analyzed one specific NOVA double-shell target design and have determined the x-ray energies required for probing the performance of the implosion. It is virtually impossible to study the compression of the fuel or the motion of the inner pusher. An x-ray energy of about 9 keV appears to be ideal for measuring the behavior of the outer TaCOH shell for the majority of its travel. However, it would be advantageous to have an x-ray source of about 25 keV to measure the contact between the two shells. Development of narrowband x-ray line sources are more desirable than broadband continuum sources since the intensity per keV is many times greater in the line. Intensities of the probes are determined by the self-emission levels of the target capsule. For the 9 keV line source, an intensity of upwards to $10^{15}$ keV/keV/sh/cm$^2$/sr is required with a source area of about 0.01 cm$^2$.

35751 **(UCID—19193) Tandem-mirror technology demonstration facility.** Fowler, T.K.; Logan, B.G. (Lawrence Livermore National Lab., CA (USA)). 18 Sep 1981. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01. Order Number DE81030878.

Preliminary calculations at LLNL indicate that a Technology Demonstration Facility (TDF) consisting of a tandem mirror machine about the size of TMX could begin providing fusion nuclear engineering data as early as 1988. With high density operation based on physics already demonstrated in TMX, this machine would produce 12 MW of DT neutrons in steady-state from a pkasma column 0.08 m in radius and 8 m in length. Allowing space for neutral beam injectors at each end of the column, this would permit testing of blanket modules and components at 1 MW/m$^2$ neutron wall load over a cylindrical surface 8 m$^2$ in area at a radius of 0.25 m; or one could irradiate thousands of small samples at 2 MW/m$^2$ at r = 0.125 m (4 m$^2$ area). With improved end-plug phys-

ics to be tested in TMX-Upgrade in 1982-83, the wall load at 0.25 m could be increased to 2 MW/m$^2$ (4 MW/m$^2$ at r = 0.125 m). Construction of the TDF could begin in FY84 and be completed in 4 to 5 years, at a cost roughly estimated as $700M in '81 dollars including engineering and 30% contingency.

**35752 (UCRL—53179) Fire-protection research for energy technology: FY 80 year-end report.** Hasegawa, H.K.; Alvares, N.J.; Lipska, A.E.; Ford, H.; Priante, S.; Beason, D.G. (Lawrence Livermore National Lab., CA (USA)). 26 May 1981. Contract W-7405-ENG-48. 118p. NTIS, PC A06/MF A01. Order Number DE82000970.

This continuing research program was initiated in 1977 in order to advance fire protection strategies for Fusion Energy Experiments (FEE). The program has since been expanded to encompass other forms of energy research. Accomplishments for fiscal year 1980 were: finalization of the fault-tree analysis of the Shiva fire management system; development of a second-generation, fire-growth analysis using an alternate moel and new LLNL combustion dynamics data; improvements of techniques for chemical smoke aerosol analysis; development and test of a simple method to assess the corrosive potential of smoke aerosols; development of an initial aerosol dilution system; completion of primary small-scale tests for measurements of the dynamics of cable fires; finalization of primary survey format for non-LLNL energy technology facilities; and studies of fire dynamics and aerosol production from electrical insulation and computer tape cassettes.

**35753 (UCRL—86195) Design of first walls and beam dumps for Tandem Mirror Experiment Upgrade.** Drake, R.P.; Lang, D.D.; Hunt, A.L. (Lawrence Livermore National Lab., CA (USA); Sandia National Labs., Livermore, CA (USA)). 15 Sep 1981. Contract W-7405-ENG-48. 16p. (CONF-811113—7). NTIS, PC A02/MF A01. Order Number DE81030888.

From American Vacuum Society national symposium; Anaheim, CA, USA (3 Nov 1981).

Neutral reflux from the first walls and beam dumps of the Tandem Mirror Experiment (TMX) Upgrade could erode the neutral-beam-fueled, end-cell plasma or cool the neutral-beam-heated, central-cell plasma. To allow the TMX Upgrade to meet its design parameters, the neutral reflux to the plasma must be much less than the fluxes of both charge-exchange neutral products to the first walls and transmitted neutral-beam atoms to the beam dumps. To achieve this, we intend to evaporate titanium as a getter on the first wall and install vanadium-foil beam dumps. The vanadium beam dumps will be heated by the neutral beam during the shot, releasing most of the implanted hydrogen as they cool radiatively after the shot. The deposited titanium will be thick enough to retain the implanted charge-exchange neutral products. We describe our design of these components, report our estimates of their performance, and compare their performance to the needs of TMX Upgrade.

**35754 (UCRL—86196) Neutral-beam systems for magnetic-fusion reactors.** Fink, J.H. (Lawrence Livermore National Lab., CA (USA)). 10 Aug 1981. Contract W-7405-ENG-48. 23p. (CONF-811113—1). NTIS, PC A02/MF A01. Order Number DE81027940.

From American Vacuum Society national symposium; Anaheim, CA, USA (3 Nov 1981).

Neutral beams for magnetic fusion reactors are at an early stage of development, and require considerable effort to make them into the large, reliable, and efficient systems needed for future power plants. To optimize their performance to establish specific goals for component development, systematic analysis of the beamlines is essential. Three ion source characteristics are discussed: arc-cathode life, gas efficiency, and beam divergence, and their significance in a high-energy neutral-beam system is evaluated.

**35755 (UCRL—86270) LLNL Tandem Mirror Experiment (TMX) upgrade vacuum system.** Pickles, W.L.; Chargin, A.K.; Drake, R.P. (Lawrence Livermore National Lab., CA (USA)). 15 Sep 1981. Contract W-7405-ENG-48. 15p. (CONF-811113—6). NTIS, PC A02/MF A01. Order Number DE81030314.

From American Vacuum Society national symposium; Anaheim, CA, USA (3 Nov 1981).

TMX Upgrade is a large, tandem, magnetic-mirror fusion experiment with stringent requirements on base pressure ($10^{-8}$ torr), low H reflux from the first walls, and peak gas pressure (5 x $10^{-7}$ torr) due to neutral beam gas during plasma operation. The 225 m$^3$ vacuum vessel is initially evacuated by turbopumps. Cryopumps provide a continuous sink for gases other than helium, deuterium, and hydrogen. The neutral beam system introduces up to 480 l/s of H or D. The hydrogen isotopes are pumped at very high speed by titanium sublimed onto two cylindrical radially separated stainless steel quilted liners with a total surface area of 540 m$^2$. These surfaces (when cooled to about 80°K) provide a pumping speed of 6 x $10^7$ l/s for hydrogen. The titanium getter system is programmable and is used for heating as well as gettering. The inner plasma liner can be operated at elevated temperatures to enhance migration of gases away from the surfaces close to the plasma. Glow discharge cleaning is part of the pumpdown procedure. The design features are discussed in conjunction with the operating procedures developed to manage the dynamic vacuum conditions.

**35756 (UCRL—86588) Progress in the tandem mirror program.** Fowler, T.K.; Borchers, R.R. (Lawrence Livermore National Lab., CA (USA)). 13 Sep 1981. Contract W-7405-ENG-48. 25p. (CONF-810906—9). NTIS, PC A02/MF A01. Order Number DE81030303.

From 10. European conference on controlled fusion and plasma physics; Moscow, USSR (14 Sep 1981).

Experimental results in TMX have confirmed the basic principles of the tandem-mirror concept. A center-cell particle confinement parameter eta tau ~ $10^{11}$ cm$^{-3}$ s has been obtained at ion temperatures around 100 eV, which is a hundred-fold improvement over single mirrors at the same temperatures. For TMX these results have been obtained at peak beta values in the center cell in the range 10 to 40%, not yet limited by MHD activity; and ion-cyclotron resonant heating (ICRH) in the Phaedrus tandem-mirror experiment has produced beta values ~ 25%, which is several times the ideal MHD limit for that device. In addition, it has been demonstrated that the end fan chambers of TMX simultaneously isolate the hot electrons from the end walls, provide adequate pumping and conveniently dispose of the exhaust plasma energy either by thermal deposition on the end wall or by direct conversion to electricity (at 48% efficiency in agreement with calculations). Also, evidence was obtained for inherent divertor action in TMX, presumably in part responsible for the observed low impurity level (<0.5% low-Z ions in the center cell).

**35757 Consolidation and fabrication of vanadium and vanadium-base alloys.** Buckman, R.W. Jr. (Westinghouse Electr Corp, Pittsburgh, PA). *International Metals Reviews ;* **25**: No. 4, 158-162(1980).

Vanadium and vanadium alloys are being considered as a potential first-wall material for fusion reactors. Currently, there is not any active capacity in the USA for producing commercial quantities of high-purity vanadium. Vanadium and vanadium alloys can be processed to all the common mill shapes using procedures similar to those followed for niobium and tantalum alloys. To avoid contamination during processing, all elevated-temperature working operations must be accomplished with suitable protection for the workpiece, i.e. encapsulation for hot extrusion, forging, and rolling and in process and final annealing a pressure of process and final annealing a pressure of /less than equivalent to/1.3*10/sup -3/ Pa. Gas-tungsten arc welds in unalloyed vanadium containing 1560 ppm C+O+N are ductile in bending at -102/degree/C. 14 refs.

**35758 (WFPS-TME—81-015) Compact Commercial Tokamak Reactor (CCTR): a concept for a 500-MWe commercial-tokamak fusion system.** Gillen, T.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA); Pennsylvania State Univ., University Park (USA). Dept. of Nuclear Engineering). Nov 1980. Contract AC02-77ET51010. 70p. NTIS, PC A04/MF A01. Order Number DE81030406.

A detailed set of self-consistent parameters and costs for the conceptual design of a Compact Commercial Tokamak Reactor (CCTR) is given. Several of the basic design features are the following: an ignited plasma with a major radius of 4.9 m and minor radius of 1.4 m; a net electrical output of 500 MW; a borated-water-cooled, stainless steel shield; and a toroidal field of 12 T at the coil.

The design, which utilizes the Westinghouse computer code for the COsting And Sizing of D-T burning Tokamaks (COAST), mainly provides the sizes and geometries associated with the definition of the main component features for which a detailed engineering design can be effectively undertaken. Design study alternatives, including a neutral beam driven design option, a design option with a toroidal field of 13 T at the coil, and a tungsten-shielded option are considered for the CCTR. Also included is the conceptual design of a Compact Fusion Engineering Device (CFED).

35759 **Negative ion source with hollow cathode discharge plasma.** Hershcovitch, A.; Prelec, K. (to Dept. of Energy). US Patent Application 215,770. 12 Dec 1980. 17p.

A negative ion source of the type where negative ions are formed by bombarding a low-work-function surface with positive ions and neutral particles from a plasma, wherein a highly ionized plasma is injected into an anode space containing the low-work-function surface is described. The plasma is formed by hollow cathode discharge and injected into the anode space along the magnetic field lines. Preferably, the negative ion source is of the magnetron type.

35760 **Star is born at los alamos.** Jansen, J.; Stratton, T.F. (Los Alamos Sci Lab). *Laser Focus ;* **16**: No. 11, 76, 80, 82, 84(Nov 1980).

Antares is a fusion-research carbon-dioxide laser currently being built at the Los Alamos Scientific Laboratory. When it begins full operation in 1983, it will deliver 40 terawatts of peak power--one-nanosecond, 40-kilojoule pulses of 10.6-micrometer light--on a deuterium-tritium target. Single-sector energy-extraction tests of the first power amplifier will begin in June 1981. It design, optical alignment system, and control system are discussed.

# 99 GENERAL AND MISCELLANEOUS

## 9901 Management

*REFER ALSO TO CITATION(S) 35766*

35761 **(DPSPU—80-30-13) Operating-procedure system at Savannah River Plant.** Tope, C.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). May 1981. Contract AC09-76SR00001. 6p. (CONF-810508—3). NTIS, PC A02/MF A01. Order Number DE81030405.

From 28. international technical communication conference; Pittsburgh, PA, USA (20 May 1981).

Three types of procedures are widely used at SRP: Du Pont Savannah Operating Logsheet, Du Pont Savannah Operating Procedure, and Plant Manual. This document briefly reviews originating of the procedures, their preparation, control, and indexing. (DLC)

## 9902 Mathematics And Computers

*REFER ALSO TO CITATION(S) 34231, 34286, 34361, 35572*

35762 **(ANL/SPG—19) Inferred referendum and its comparison with Borda voting.** Wolsky, A.M.; Sanathanan, L.P. (Argonne National Lab., IL (USA)). May 1980. Contract W-31-109-ENG-38. 40p. NTIS, PC A03/MF A01. Order Number DE82000170.

A new amalgamation procedure or method of social choice, the inferred referendum, is presented and compared with Borda voting. The procedure has an unrestricted domain and satisfies the principles of unanimity, anonymity, and neutrality. The procedure agrees with majority voting, MMD, when MMD is transitive. When MMD is intransitive, the inferred referendum orders the alternatives through the solution of a constrained maximum-likelihood problem. This problem is the same as one would solve to infer the beliefs of a transitive population from a random sample. If, in fact, the decision makers represent a constituency, attention must also be given to a figure of merit whose value might indicate when to defer action based on the result of the inferred referendum. A different amalgamation procedure, Borda voting, is described as a simple example of a large class of natural procedures. Each of these procedures is shown to have two associated quantities that together generalize Kendall's coefficient of concordance, W; the relation of this coefficient to pairwise votes, and thus to MMD and Borda voting, is also described. A detailed comparison of Borda voting and the inferred referendum is given for the case of three alternatives. In that case, the procedure depends only on pairwise votes, where the two procedures differ is shown, the procedure violates Sen's property $\alpha$ less than does Borda's, and the maximum value of W for which MMD can be intransitive and the maximum value of W for which the inferred referendum, MMD, and Borda voting can differ are found.

35763 **(DOE/MA—0006/2) Quarterly status of Department of Energy projects.** (Department of Energy, Washington, DC (USA). Office of the Controller). 30 Jun 1981. 525p. NTIS, PC A22/MF A01. Order Number DE82000038.

This is a quarterly report on Department of Energy projects prepared by the Office of Project and Facilities Management, MA-30. The report is designed to provide Department of Energy (DOE) management with a summary of the important baseline data that exists in the DOE project data base. This data base is maintained chiefly from periodic field management reports required by DOE Order 5700.4. Since most of the current estimates in this report are from field project managers, they do not necessarily have full Headquarters approval. The current budget data sheet estimates that appear in the report are considered appropriate for reporting external to the Department.

35764 **(DOE/MA—0025) Autopreps data base for cost-reimbursement support services or nonnuclear R & D procurements.** (Department of Energy, Washington, DC (USA). Office of Procurement Operations). Sep 1981. 178p. NTIS, PC A09/MF A01. Order Number DE82000045.

35765 **(LA-UR—81-2138) Regional Monte Carlo solution of elliptic partial differential equations.** Booth, T.E. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 8p. (CONF-811103—19). NTIS, PC A02/MF A01. Order Number DE81028772.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

A continuous random walk procedure for solving some elliptic partial differential equations at a single point is generalized to estimate the solution everywhere. The Monte Carlo method described here is exact (except at the boundary) in the sense that the only error is the statistical sampling error that tends to zero as the sample size increases. A method to estimate the error introduced at the boundary is provided so that the boundary error can always be made less than the statistical error.

35766 **(LA-UR—81-2587) Long-range prediction of network traffic.** Alexander, W.; Brice, R. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 9p. (CONF-811118—1). NTIS, PC A02/MF A01. Order Number DE81030241.

From Computer performance evaluation users group meeting; San Antonio, TX, USA (16 Nov 1981).

A method of making long-range computer system workload predictions is presented. The method quantifies the effect of qualitative changes in computing by identifying assumptions and by considering the effect of a change on individual users. The method is illustrated by an example involving message traffic in a large computer network.

35767 **(LBL—12313) Use of embedded microcomputers in system debugging and maintenance.** Meng, J.; Weaver, D. (Lawrence Berkeley Lab., CA (USA)). Feb 1981. Contract W-7405-ENG-48. 6p. (CONF-811115—2). NTIS, PC A02/MF A01. Order Number DE81029859.

From IEEE conference on applications of mini and microcomputers; San Francisco, CA, USA (9 Nov 1981).

Systems which use embedded microcomputers to perform control functions can often double as flexible debugging and main-

tenance devices by switching in high level language ROMS. This paper describes systems in which such benefits are successfully exploited.

35768 **(SAND—81-0463) MERLIN: a computer program to transfer data between finite-element meshes.** Gartling, D.K. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1981. Contract AC04-76DP00789. 45p. NTIS, PC A03/MF A01. Order Number DE82000806.

The MERLIN program is designed to transfer data between two-dimensional, finite element meshes of arbitrary geometry. The program is structured to accurately interpolate previously computed solutions onto a given mesh and format the resulting data for immediate use in a variety of existing finite element codes. The theoretical basis and computational algorithms used in the program are described and complete user instructions are presented. Several example problems are included to demonstrate program usage.

35769 **(UCID—19191) SCALD II logic simulator.** Rubin, J.B. (Lawrence Livermore National Lab., CA (USA)). 17 Sep 1981. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01. Order Number DE81030879.

The SCALD II design system is a set of computer-aided logic design programs written in a structured, high-level language, Pascal, which facilitates the design and implementation of synchronous digital systems. SCALD II is divided into two major sub-categories: the Logical and Physical Design Subsystems. The Logical Design Subsystem consists of the Macro Expander, Timing Verifier, and Logic Simulator programs, whereas the Physical Design Subsystem consists of the Layout Program and the Packager. This paper describes the Logic Simulator and gives enough background information on the rest of the Logical Design Subsystem to permit the Logic Simulator to be seen in its actual context.

35770 **(UCRL—85694) Technology transfer of computer-aided engineering to the university community.** Comfort, W.J. III Brown, B.E.; Bowman, B.R.; Harral, A. III. (Lawrence Livermore National Lab., CA (USA)). Apr 1981. Contract W-7405-ENG-48. 17p. (CONF-811101—1). NTIS, PC A02/MF A01.

From Winter annual meeting of the ASME Technology and Society Division; Washington, DC, USA (15 Nov 1981).

Computer aided engineering, which includes modeling, analysis, and design - with graphical representation for both input and output - is becoming an increasingly important contributor to national productivity. The demand for persons skilled in this field is growing rapidly. It is expected that the needs for such skills will far exceed the ability of the university community to supply them, unless something is done now. The Lawrence Livermore National Laboratory (LLNL) has initiated a new project, in cooperation with the university community, to increase the student's use of and familiarity with the computer in engineering schools. The ultimate objective is increasing the national productivity. This paper is an announcement, an invitation, and a progress report describing the LLNL program.

35771 **(UCRL—85694(Rev.1)) Technology transfer and development of computer-aided engineering with the university community.** Comfort, W.J. III; Brown, B.E.; Bowman, B.R.; Harral, A. III. (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 8p. (CONF-811101—1(Rev.1)). NTIS, PC A02/MF A01. Order Number DE81022408.

From Winter annual meeting of the ASME Technology and Society Division; Washington, DC, USA (15 Nov 1981).

Computer-aided engineering (CAE), the process of using the computer interactively for modeling, analysis, and design with graphical representation for both input and output, is becoming an increasingly important contributor to engineering productivity. The demand for persons skilled in this field is growing rapidly. The need for such skills will exceed the ability of the university community to supply them, unless something is done now. The Lawrence Livermore National Laboratory (LLNL) has initiated a new technology transfer project in cooperation with the university community. The objectives of this program are to increase the student's use of and familiarity with the computer in engineering schools and ultimately to assist in increasing engineering productivity.

35772 **(UCRL—85837) Incomplete block cyclic reduction.** Rodrigue, G.; Wolitzer, D. (Lawrence Livermore National Lab., CA (USA); Wellesley Coll., MA (USA)). 17 Apr 1981. Contract W-7405-ENG-48. 18p. (CONF-811102—1). NTIS, PC A02/MF A01.

From 2. IMACS international symposium on parallel computation; Newark, DE, USA (9 Nov 1981).

Iterative methods for solving linear systems arising from the differencing of partial differential equations require the use of preconditioners to gain increased rates of convergence. Preconditioners arising from incomplete factorizations have been shown to be very effective. However, the recursiveness of these methods can offset these gains somewhat on a parallel processor. In this paper, an incomplete factorization using odd-even shuffles are developed and compared to other methods on the CRAY-1. Multi-processor considerations for these algorithms will also be discussed.

35773 **(UCRL—96693) 3-D on the 7600-Star-Cray.** Kransky, V. (Lawrence Livermore National Lab., CA (USA)). 17 Sep 1981. Contract W-7405-ENG-48. 18p. (CONF-810960—1). NTIS, PC A02/MF A01. Order Number DE81030889.

From CRAY user conference; Schliersee, F.R. Germany (28 Sep 1981).

C0M3 is a large three-dimensional Eulerian Program (over 2500 vector flops per cycle) which was formulated to make use of vectors entirely (>99%). C0M3 was programmed to make use of Class VI computers efficiently and achieves Class VI high performance execution rates on both the Star and Cray computers (28 to 32 megaflops net rate). A comparison of the C0M3 performance on the 7600, Star and Cray computers is given with emphasis on how the program achieved its current execution rate on the Cray.

35774 **Hydrocode subcycling stability.** Hicks, D.L. DE-AC04-76-DP00789. *Mathematics of Computation ;* **36**: No. 155, 69-78(Jul 1981).

The method of artificial viscosity was originally designed by von Neumann and Richtmyer for calculating the propagation of waves in materials that were hydrodynamic and rate-independent (e.g., ideal gas law). However, hydrocodes (such as WONDY) based on this method continue to expand their repertoire of material laws even unto material laws that are rate-dependent (e.g., Maxwell's material law). Restrictions on the timestep required for stability with material laws that are rate-dependent can be considerably more severe than restrictions of the Courant-Friedrichs-Lewy (CFL) type that are imposed in these hydrocodes. These very small timesteps can make computations very expensive. An alternative is to go ahead and integrate the conservation laws with the usual CFL timestep while subcycling (integrating with a smaller timestep) the integration of the stress-rate equation. If the subcycling is done with a large enough number of subcycles (i.e., with a small enough subcycle timestep), then the calculation is stable. Specifically, the number of subcycles must be one greater than the ratio of the CFL timestep to the relaxation time of the material.

35775 **Krylov subspace methods for solving large unsymmetric linear systems.** Saad, Y. EY-76-S-02-2383. *Mathematics of Computation ;* **36**: No. 155, 105-126(Jul 1981).

Some algorithms based upon a projection process onto the Krylov subspace K/sub m/ = Span($r_0$, $Ar_0$,...,A/sup m/-1$r_0$) are developed, generalizing the method of conjugate gradients to unsymmetric systems. These methods are extensions of Arnoldi's algorithm for solving eigenvalue problems. The convergence is analyzed in terms of the distance of the solution to the subspace K/sub m/ and some error bounds are established showing, in particular, a similarity with the conjugate gradient method (for symmetric matrices) when the eigenvalues are real. Several numerical experiments are described and discussed.

## 9903 Information Handling

*REFER ALSO TO CITATION(S) 34259*

35776 **(ORNL/CSD—85) Preliminary internal data screening - a component of quantitative data analysis in data validation.** Pack, D.J. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 35p. NTIS, PC A03/MF A01. Order Number DE81000502.

Internal data screening is validation of data by quantitative internal comparisons across records for a given variable, across variables for a given record, across time for a given variable and record, etc. Preliminary internal data screening has the objectives of producing 1) a frozen, archived data base ready for efficient computer analysis and 2) a general understanding of key variables, a rough cut at response meaningfulness, a qualification of the type of error present, and an assessment of the expected level of difficulty in the comprehensive validation. The relatively less important first objective is defined. It is seen to be achievable through simple computer methodology. The second objective is the paper's major focus. Initial methodological suggestions for accomplishing this objective centering upon the exploratory data analysis techniques of Tukey are made, recognizing these techniques appropriateness for a general examination of a large data base that may contain numerous errors.

## 9905 Civilian Defense

35777 **(ORNL—5766) Proposed new handbook for the Federal Emergency Management Agency: radiation safety in shelters.** Haaland, C.M. (Oak Ridge National Lab., TN (USA)). Sep 1981. Contract W-7405-ENG-26. 143p. NTIS, PC A07/MF A01. Order Number DE82000441.

This handbook is proposed to replace the portion of the current Handbook for Radiological Monitoring that deals with protection of people in shelters from radiation from fallout resulting from nuclear war. Basic information at a high-school level is given on how to detect nuclear radiation, how to find and improve the safest places in a shelter, the necessity for and how to keep records on individual radiation exposures, and how to minimize exposures. Several new procedures are introduced, some of which are based more on theoretical considerations than on actual experiments. These procedures include: the method of time-averaging radiation readings taken with one instrument in different locations of a large shelter while fallout is coming down and radiation levels are climbing too rapidly for direct comparison of readings to determine the safest location; the method of using one's body to obtain directionality in radiation readings taken with a standard Civil Defense Survey meter; the method of using mutual shielding to reduce the average radiation exposure to shelter occupants; and the ratio method for estimating radiation levels in hazardous areas.

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Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (DOE/TIC-4585) is used in the standardization of corporate entries. DOE/TIC-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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**Qualifier**
Title, (supplementary information), citation number, (report number)

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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| | 6:34359 | DP—1582 |
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| | 6:34376 | DP-MS—81-33 |
| | 6:34377 | DPSPU—80-30-9 |
| | 6:34378 | DPSTD—80-38 |
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| | 6:35497 | DPSPU—81-30-3 |
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| **AC09-78ET35900** | **Allied-General Nuclear Services, Barnwell, SC (USA)** | |
| | 6:34354 | AGNS—35900-CONF-130 |
| **AC13-76GJ01664** | **Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations** | |
| | 6:34321 | GJBX—78-81 |
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| | 6:34349 | GJBX—327-81-Vol.2-SHERBROOKE |
| | 6:34350 | GJBX—327-81-Vol.2-UTICA |
| **AC14-76FF02170** | **Hanford Engineering Development Lab., Richland, WA (USA)** | |
| | 6:34361 | HEDL-TC—1601-Rev.1 |
| | 6:35190 | HEDL-SA—2336-FP |

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| | 6:35740 | HEDL-SA—2508 |
| **AC21-76ET10381** | **Georgetown Univ., Washington, DC (USA)** | |
| | 6:34951 | DOE/ET/10381—197 |
| **AC21-76ET10389** | **Combustion Engineering, Inc., Windsor, CT (USA)** | |
| | 6:35355 | CONF-8004173—1 |
| **AC21-78ET11031** | **General Electric Co., Schenectady, NY (USA)** | |
| | 6:35362 | DOE/ET/11031—T1 |
| **AC21-78MC16823** | **Science Applications, Inc., Morgantown, WV (USA)** | |
| | 6:34301 | DOE/MC/16823—T1 |
| **AC21-79ET15167** | **Aerojet Energy Conversion Co., Sacramento, CA (USA)** | |
| | 6:35356 | DOE/ET/15167—191 |
| **AC21-79MC10389** | **Tetra Tech, Inc., Columbus, OH (USA)** | |
| | 6:34297 | DOE/METC—118 |
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| **AC22-76ET10154** | **Southern Co. Services, Inc., Birmingham, AL (USA)** | |
| | 6:34207 | DOE/ET/10154—T16 |
| **AC22-76ET10495** | **Montana State Univ., Bozeman (USA). Dept. of Chemical Engineering** | |
| | 6:34208 | DOE/ET/10495—T2 |
| **AC22-78ET10038** | **Radmark Engineering, Inc., Portland, OR (USA)** | |
| | 6:34269 | DOE/ET/10038—T1 |
| **AC22-80PC30013** | **Pennsylvania State Univ., University Park (USA). Coal Research Section** | |
| | 6:34252 | DOE/PC/30013—5 |
| **AC22-80PC30076** | **United Coal Co., Bristol, VA (USA)** | |
| | 6:34264 | DOE/PC/30076—T3 |
| **AC22-80PC30098** | **Bioassay Systems Corp., Woburn, MA (USA)** | |
| | 6:34277 | DOE/PC/30098—T1 |
| | 6:34278 | DOE/PC/30098—T2 |
| **AC22-80PC30264** | **Occidental Research Corp., Irvine, CA (USA)** | |
| | 6:34212 | DOE/PC/30264—09 |
| **AC22-80PC30293** | **Physical Sciences, Inc., Woburn, MA (USA)** | |
| | 6:34236 | DOE/PC/30293—3 |
| **AC22-80PC30297** | **Energy and Environmental Research Corp., Santa Ana, CA (USA)** | |
| | 6:35358 | DOE/PC/30297—T4 |
| **AI01-76ET12548** | **Jet Propulsion Lab., Pasadena, CA (USA)** | |
| | 6:34257 | DOE/ET/12548—7 |
| **AI01-76ET53020** | **Naval Research Lab., Washington, DC (USA)** | |
| | 6:35741 | NRL-MR—4626 |
| **AI01-77CS51044** | **National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center** | |
| | 6:35112 | DOE/NASA/51044—21 |
| **AI01-77ET10350** | **National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center** | |
| | 6:34294 | DOE/NASA/0152—1 |
| **AI01-77ET10769** | **National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center** | |
| | 6:34995 | DOE/NASA/10769—10 |
| **AI01-79ET25204** | **Mitre Corp., McLean, VA (USA)** | |
| | 6:34928 | DOE/CS/25204—01 |
| **AI03-79ET33062** | **Jet Propulsion Lab., Pasadena, CA (USA)** | |
| | 6:35002 | DOE/ET/33062—T3 |
| | 6:35003 | DOE/ET/33062—T4 |
| **AI04-80AL12726** | **National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center** | |
| | 6:35006 | DOE/NASA/12726—10 |
| **AI97-81ET46633** | **Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Structures Lab.** | |
| | 6:34372 | DOE/ET/46633—T1 |
| | 6:34373 | DOE/ET/46633—T2 |
| **AM21-79MC11284** | **West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering** | |
| | 6:35357 | DOE/MC/11284—1100 |
| **AS02-76ET-53016** | **Columbia Univ., New York (USA). School of Engineering and Applied Science** | |
| | 6:35700 | DOE/ET/53016—74 |
| **AS02-76ER03158** | **Cornell Univ., Ithaca, NY (USA)** | |
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| | 6:35184 | DOE/ER/03158—99 |
| | 6:35663 | DOE/ER/03158—98 |
| **AS02-76ET53051** | **Wisconsin Univ., Madison (USA)** | |
| | 6:35701 | DOE/ET/53051—26 |
| **AS02-76EV02161** | **Wisconsin Univ., Madison (USA). Dept. of Bacteriology** | |
| | 6:34423 | DOE/EV/02161—T1 |
| **AS02-76EV02403** | **Massachusetts General Hospital, Boston (USA)** | |
| | 6:35477 | DOE/EV/02403—T1 |
| **AS02-76EV02428** | **Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.** | |
| | 6:34852 | MIT-EL—80-005 |
| **AS02-76EV02777** | **Michigan Research Center, Inc., East Lansing (USA)** | |
| | 6:35487 | DOE/EV/02777—5 |
| **AS02-77ET29100** | **Purdue Univ., Lafayette, IN (USA). School of Electrical Engineering** | |
| | 6:34670 | DOE/ET/29100—T1 |
| **AS02-77EV04533** | **Society of Nuclear Medicine, New York (USA)** | |
| | 6:35488 | DOE/EV/04533—T2 |
| **AS02-78ER04903** | **Colorado State Univ., Fort Collins (USA)** | |
| | 6:35275 | DOE/ER/04903—3 |
| **AS02-78ET52048** | **Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering** | |
| | 6:35186 | DOE/ET/52048—18 |
| **AS02-79ER10044** | **Purdue Research Foundation, Lafayette, IN (USA)** | |
| | 6:34514 | DOE/ER/10044—T1 |
| **AS02-79ER10396** | **Colorado Univ., Boulder (USA)** | |
| | 6:35293 | DOE/ER/10396—T1 |
| **AS03-78ET13095** | **Utah Univ., Salt Lake City (USA). Coll. of Mines and Mineral Industries** | |
| | 6:34309 | DOE/ET/13095—T1 |
| **AS05-76CS35101** | **North Carolina State Univ., Raleigh (USA). Dept. of Mechanical and Aerospace Engineering** | |
| | 6:34637 | DOE/CS/35101—T1 |
| **AS05-76ER01797** | **Florida State Univ., Tallahassee (USA). Dept. of Chemistry** | |
| | 6:35303 | DOE/ER/01797—T1 |
| **AS05-76ER04535** | **Texas Southern Univ., Houston (USA). Dept. of Chemistry** | |
| | 6:35235 | DOE/ER/04535—8 |
| **AS05-76EV04157** | **North Carolina Univ., Chapel Hill (USA). Dept. of Biochemistry** | |
| | 6:35491 | DOE/EV/04157—T1 |
| | 6:35492 | DOE/EV/04157—T2 |
| | 6:35493 | DOE/EV/04157—T3 |
| **AS05-77ET11288** | **Auburn Univ., AL (USA). Dept. of Mechanical Engineering** | |
| | 6:34516 | DOE/ET/11288—T5 |
| **AS05-77EV05596** | **Tulsa Univ., OK (USA)** | |
| | 6:34287 | DOE/EV/05596—T1 |
| **AS05-78EV05888** | **Florida State Univ., Tallahassee (USA)** | |
| | 6:35478 | DOE/EV/05888—T2 |
| | 6:35518 | DOE/EV/05888—4 |
| **AS05-80ER10599** | **Georgia Inst. of Tech., Atlanta (USA). School of Physics** | |
| | 6:35644 | DOE/ER/10599—T1 |

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| **AT03-76ET28384** | **University of Southern California, Los Angeles (USA). Dept. of Petroleum Engineering** | |
| | 6:34642 | DOE/ET/28384—T1 |
| **AT03-76ET51011** | **General Atomic Co., San Diego, CA (USA)** | |
| | 6:35189 | GA-A—16389 |
| | 6:35704 | GA-A—16460 |
| | 6:35738 | GA-A—16445 |
| **AT03-76SF70030** | **General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.** | |
| | 6:34846 | DOE/SF/70030—T45 |
| **AT03-76SF71031** | **General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.** | |
| | 6:34793 | DOE/SF/71031—T25 |
| **AT03-76SF71032** | **General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.** | |
| | 6:34847 | DOE/SF/71032—T39 |
| **AT03-80SF11512** | **General Atomic Co., San Diego, CA (USA)** | |
| | 6:35704 | GA-A—16460 |
| **AT04-81AL16228** | **Jet Propulsion Lab., Pasadena, CA (USA)** | |
| | 6:34543 | DOE/JPL—1060-46 |
| **AT06-79EV10270** | **Washington Univ., Seattle (USA)** | |
| | 6:35484 | DOE/EV/10270—T1 |
| **AT06-80EV10415** | **Alaska Univ., College (USA). Inst. of Arctic Biology** | |
| | 6:35439 | DOE/EV/10415—1 |
| **FC02-80CS30375** | **Madison Industries, Inc., Conyers, GA (USA)** | |
| | 6:34596 | DOE/CS/30375—T1 |
| **FC03-79SF10762** | **Petro-Lewis Corp., Denver, CO (USA)** | |
| | 6:34282 | DOE/SF/10762—T3 |
| **FC20-78LC10787** | **Geokinetics, Inc., Concord, CA (USA)** | |
| | 6:34313 | DOE/LC/10787—80 |
| | 6:34314 | DOE/LC/10787—80-App.D-Vol.1 |
| | 6:34315 | DOE/LC/10787—80-App.D-Vol.2 |
| **FG01-79CS30013** | **Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center** | |
| | 6:34939 | DOE/CS/30013—T2 |
| | 6:34940 | DOE/CS/30013—T3 |
| | 6:34941 | DOE/CS/30013—T4 |
| **FG01-80CS30544** | **Florida Solar Energy Center, Cape Canaveral (USA)** | |
| | 6:34567 | CONF-801253— |
| **FG02-78IR05106** | **Chicago, City of, IL (USA)** | |
| | 6:35098 | DOE/IR/05106—T47 |
| **FG02-80IR10855** | **Lincoln Land Community Coll., Springfield, IL (USA)** | |
| | 6:35177 | DOE/IR/10855—T1 |
| **FG03-79ET37035** | **California State Dept. of Conservation, Sacramento (USA). Div. of Mines and Geology** | |
| | 6:34643 | DOE/ET/37035—T1 |
| | 6:34644 | DOE/ET/37035—T2 |
| **FG03-80SF11442** | **San Bernardino Municipal Water Dept., CA (USA)** | |
| | 6:34663 | DOE/SF/11442—T2 |
| **FG07-80RA50308** | **Ultrasystems, Inc., Irvine, CA (USA)** | |
| | 6:34520 | DOE/RA/50308—1 |
| **FG07-80RA50331** | **AGRI Grain Power, Des Moines, IA (USA)** | |
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| | 6:34470 | DOE/RA/50331—T1(Vol.2) |
| | 6:34471 | DOE/RA/50331—T1(Vol.3) |
| **FG07-80RA50357** | **ANDCO Environmental Processes, Inc., Buffalo, NY (USA)** | |
| | 6:34472 | DOE/RA/50357—T1 |
| **FG07-80RA50365** | **Fulton Energy Corp., Tulsa, OK (USA)** | |
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| **FG07-80RA50391** | **Dvorak Farms, Inc., Whitelaw, WI (USA)** | |
| | 6:34477 | DOE/RA/50391—T1 |
| **FG18-79FC14690** | **Maine Office of Energy Resources, Augusta (USA)** | |
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| **FG21-78ET13383** | **Clarkson Coll. of Tech., Potsdam, NY (USA)** | |
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| **FG22-78ET11432** | **Lawrence Berkeley Lab., CA (USA)** | |
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| **FG22-78ET13380** | **North Dakota Univ., Grand Forks (USA)** | |
| | 6:34233 | DOE/ET/13380—T1 |
| **FG22-80PC30213** | **Wisconsin Univ., Madison (USA). Dept. of Mechanical Engineering** | |
| | 6:34271 | DOE/PC/30213—T1 |
| **FG22-80PC30217** | **Cornell Univ., Ithaca, NY (USA)** | |
| | 6:34234 | DOE/PC/30217—T2 |
| **FG22-80PC30249** | **Oklahoma Univ., Norman (USA). School of Chemical Engineering and Materials Science** | |
| | 6:34235 | DOE/PC/30249—T2 |
| **FG51-79R000079** | **Washington State Government, Olympia (USA)** | |
| | 6:34651 | WAOENG—80-16 |
| **NAS-7-100-955909** | **Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.** | |
| | 6:34519 | DOE/JPL/955909—81/3 |
| **W-31-109-ENG-38** | **Argonne National Lab., IL (USA)** | |
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| **W-7405-ENG-26** | **Oak Ridge National Lab., TN (USA)** | |
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| **W-7405-ENG-36** | **Los Alamos National Lab., NM (USA)** | |
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| **W-7405-ENG-48** | **Lawrence Berkeley Lab., CA (USA)** | |
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| 1 | 6:35114 | *See* LBL-13109 |
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| 2 | 6:34377 | *See* DPSPU-80-30-9 |
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| 3 | 6:35627 | *See* SLAC-PUB-2754 |
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| 1 | 6:35485 | *See* BNL-30027 |
| CONF-810508- | | (28. international technical communication conference, Pittsburgh, PA, USA, 20-23 May 1981) |
| 3 | 6:35761 | *See* DPSPU-80-30-13 |
| CONF-810511- | | (Workshop on ambipolar potential formation and control in bumpy tori and mirrors, Oak Ridge, TN, USA, 11-12 May 1981) |
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| 8 | 6:34995 | *See* DOE/NASA/10769-10 |
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| 1 | 6:35553 | *See* LBL-13156 |
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| CONF-810613- | | (Conference on lasers and electro-optics, Washington, DC, USA, 10-12 Jun 1981) |
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| 9 | 6:34564 | *See* LBL-13208 |
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| 7 | 6:35497 | *See* DPSPU-81-30-3 |
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| 13 | 6:35532 | *See* PNL-SA-9137 |
| CONF-810745- | | (IAEA technical committee meeting on divertors and impurity control in tokamaks, Garching, F.R. Germany, 6-9 Jul 1981) |
| 2 | 6:35738 | *See* GA-A-16445 |
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| 6 | 6:35366 | *See* BNL-29985 |
| CONF-810757- | | (56. annual conference of the western economic association, San Francisco, CA, USA, 3 Jul 1981) |
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| 18 | 6:35182 | NTIS, PC A02/MF A01. Order Number DE82000148, Distribution Category MN -4 |
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| 40 | 6:35740 | *See* HEDL-SA-2508 |
| 41 | 6:35190 | *See* HEDL-SA-2336-FP |
| 43 | 6:35191 | *See* HEDL-SA-2474-FP |
| 56 | 6:35739 | *See* HEDL-SA-2355-FP |
| 57 | 6:35189 | *See* GA-A-16389 |
| CONF-810840- | | (Symposium on neutron scattering, Argonne, IL, USA, 12-14 Aug 1981) |
| 5 | 6:35662 | *See* BNL-29957 |
| CONF-810841- | | (12. NATO/CCMS international technical meeting on air pollution modeling and its applications, Menlo Park, CA, USA, 25-28 Aug 1981) |
| 3 | 6:35409 | *See* BNL-29924 |
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| 1 | 6:35513 | NTIS, PC A03/MF A01. Order Number DE81028564, Distribution Category MN -41 |
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| 3 | 6:34389 | *See* SAND-81-1293C |
| CONF-810864- | | (International conference on low-dimensional conductors, Boulder, CO, USA, 10-14 Aug 1981) |
| 2 | 6:35668 | *See* SAND-81-1115C |
| CONF-810868- | | (6. international conference on fast ion beam spectroscopy, Quebec, Canada, 17-20 Aug 1981) |
| 2 | 6:35676 | *See* BNL-29948 |
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| 1 | 6:35584 | *See* BNL-29984 |
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| 2 | 6:35535 | *See* UCRL-86611 |
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| 2 | 6:35220 | *See* DOE/ER/01198-1365 |
| 3 | 6:35219 | *See* DOE/ER/01198-1364 |
| 4 | 6:35221 | *See* DOE/ER/01198-1366 |
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| 1 | 6:35665 | *See* UCRL-85576 |
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| 10 | 6:35496 | NTIS, PC A02/MF A01. Order Number DE82000136, Distribution Category MN -41 |
| **CONF-810906-** | (10. European conference on controlled fusion and plasma physics, Moscow, USSR, 14-19 Sep 1981) | |
| 9 | 6:35756 | *See* UCRL-86588 |
| 10 | 6:35698 | NTIS, PC A02/MF A01. Order Number DE81032003, Distribution Category MN -20f |
| **CONF-810909-** | (International gas research conference, Los Angeles, CA, USA, 28 Sep-1 Oct 1981) | |
| 5 | 6:35426 | *See* LBL-12886 |
| 6 | 6:35010 | NTIS, PC A02/MF A01. Order Number DE81032028, Distribution Category MN -95d |
| 7 | 6:35011 | NTIS, PC A02/MF A01. Order Number DE81031991, Distribution Category MN -95d |
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| **CONF-810920-** | (4. international symposium on neutron-capture gamma-ray spectroscopy and related topics, Grenoble, France, 7-11 Sep 1981) | |
| 14 | 6:35647 | *See* UCRL-85325 |
| 15 | 6:35648 | *See* UCRL-86268 |
| **CONF-810923-** | (7. underground coal conversion symposium, Fallen Leaf Lake, CA, USA, 8-12 Sep 1981) | |
| 9 | 6:34221 | *See* SAND-81-1941C |
| 10 | 6:34223 | *See* UCRL-85907 |
| **CONF-810926-** | (11. symposium on explosives and pyrotechniques, Philadelphia, PA, USA, 15-17 Sep 1981) | |
| 5 | 6:35396 | *See* MLM-2860-OP |
| **CONF-810940-** | (Annual contractors' review meeting on thermal and chemical storage, Tysons Corner, VA, USA, 16 Sep 1981) | |
| 3 | 6:34973 | *See* BNL-29962 |
| 4 | 6:34923 | NTIS, PC A02/MF A01. Order Number DE81032029, Distribution Category MN -94a |
| 5 | 6:34925 | *See* LA-UR-81-2513 |
| 6 | 6:34924 | NTIS, PC A02/MF A01. Order Number DE81032032, Distribution Category MN -94a |
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| **CONF-810942-** | (International Energy Agency Annex I workshop on thermochemical hydrogen, Julich, F.R. Germany, 23-25 Sep 1981) | |
| 4 | 6:34413 | *See* LA-UR-81-2627 |
| **CONF-810944-** | (9. international conference on cyclotrons and their applications, Caen, France, 7-10 Sep 1981) | |
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| 5 | 6:35370 | *See* DOE/ER/40014-5 |
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| 1 | 6:34933 | *See* SAND-81-1955C |
| 2 | 6:35248 | NTIS, PC A02/MF A01. Order Number DE81030130, Distribution Category MN -4 |
| 3 | 6:35216 | *See* UCRL-86034 |
| **CONF-810954-** | (COMPUMAG conference, Argonne, IL, USA, 14-17 Sep 1981) | |
| 1 | 6:35749 | *See* SAND-81-2001C |
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| **CONF-810958-** | (NATO advanced study summer institute, Baddeck, Nova Scotia, Canada, 13-26 Sep 1981) | |
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| **CONF-810959-** | (2. EPA/NCI annual collaborative workshop on environmental and occupational cancer studies, Rockville, MD, USA, 9-11 Sep 1981) | |
| 1 | 6:35514 | NTIS, PC A02/MF A01. Order Number DE81030813, Distribution Category MN -41 |
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| **CONF-810961-** | (Institute of Electrical and Electronics Engineers conference, Atlanta, GA, USA, Sep 1981) | |
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| 1 | 6:35412 | NTIS, PC A02/MF A01. Order Number DE81032004, Distribution Category MN -11 |
| **CONF-810964-** | (Seminar on iodine removal from gaseous effluents in the nuclear industry, Mol, Belgium, 21-24 Sep 1981) | |
| 1 | 6:34845 | NTIS, PC A02/MF A01. Order Number DE81030810, Distribution Category MN -78 |
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| 1 | 6:35471 | NTIS, PC A02/MF A01. Order Number DE81030807, Distribution Category MN -41 |
| **CONF-810966-** | (4. international symposium of the Radiation Biology Center, Kyoto, Japan, 28-29 Sep 1981) | |
| 1 | 6:35515 | NTIS, PC A02/MF A01. Order Number DE81031999, Distribution Category MN -48 |
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| 1 | 6:35516 | NTIS, PC A03/MF A01. Order Number DE81030916, Distribution Category MN -11 |
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| 1 | 6:34411 | NTIS, PC A02/MF A01. Order Number DE81030811, Distribution Category MN -23 |
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| 1 | 6:34369 | *See* UCRL-86100 |
| **CONF-810973-** | (7. international meeting on N-nitroso compounds: occurrence and biological effects, Tokyo, Japan, 28 Sep-1 Oct 1981) | |
| 1 | 6:35517 | NTIS, PC A02/MF A01. Order Number DE81030808, Distribution Category MN -48 |
| **CONF-811010-** | (6. electric vehicle council symposium, Baltimore, MD, USA, 21-23 Oct 1981) | |
| 4 | 6:34934 | *See* SAND-81-7147C |
| 5 | 6:35112 | *See* DOE/NASA/51044-21 |
| **CONF-811013-** | (Electrochemical Society conference, Denver, CO, USA, 11-16 Oct 1981) | |
| 4 | 6:34935 | *See* UCRL-86648 |
| **CONF-811015-** | (Geothermal Resources Council annual meeting, Houston, TX, USA, 25-29 Oct 1981) | |
| 15 | 6:34658 | *See* LA-UR-81-2529 |
| **CONF-811025-** | (25. conference on analytical chemistry and nuclear technology, Gatlinburg, TN, USA, 6 Oct 1981) | |
| 1 | 6:35238 | *See* LA-UR-81-2533 |
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| 1 | 6:35707 | *See* UCRL-85579 |
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| 2 | 6:34497 | *See* BNL-29963 |

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| 1 | 6:35770 | *See* UCRL-85694 |
| 1(Rev.1) | 6:35771 | *See* UCRL-85694(Rev.1) |
| 3 | 6:34561 | *See* SAND-81-0572C |
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| 12 | 6:34354 | *See* AGNS-35900-CONF-130 |
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| 41 | 6:35721 | *See* BNL-30002 |
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| 1(Rev.1) | 6:35401 | *See* UCRL-85525-Rev.1 |
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| 7 | 6:35424 | *See* LA-UR-81-2087 |
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| 3 | 6:34220 | *See* SAND-81-0211C |
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